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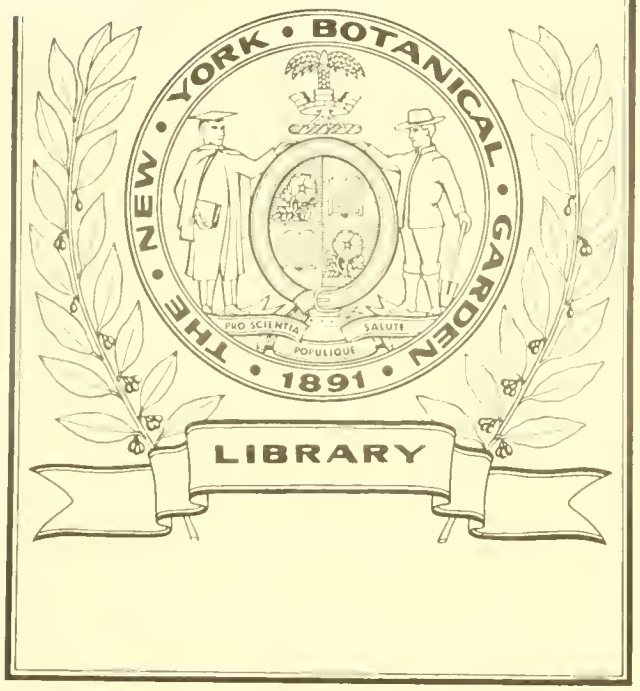

TRANSACTIONS

OF THE

AMERICAN PHILOSOPHICAL SOCIETY.

HELD AT PHILADELPHIA,

FOR PROMOTING USEFUL KNOWLEDGE.

VOL. X.—NEW SERIES.

PUBLISHED BY THE SOCIETY.

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EXTRACT

FROM THE LAWS OF THE SOCIETY RELATING TO THE TRANSACTIONS.

1. The Transactions shall be published in numbers, at short intervals, under the direction of the Committee of Publication.

2. Every communication to the Society, which may be considered as intended for a place in the Transactions, shall immediately be referred to a committee to consider and report thereon.

3. If the committee shall report in favour of publishing the communication, they shall make such corrections therein as they may judge necessary to fit it for the Press; or, if they shall judge the publication of an abstract or extracts from the paper to be most eligible, they shall accompany their report with such abstract or extracts. But if the author do not approve of the corrections, abstracts, or extracts, reported by the committee, he shall be at liberty to withdraw his paper.

4. The order in which papers are read before the Society shall determine their places in the Transactions, priority of date giving priority of location.

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Don M. F. de Navarrete, of Madrid.
Alexander Everett, of Massachusetts.
James Kent, of New York.
James Ross, of Pittsburgh.
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G. M. Zecchinelli, of Padua.
Charles Alexandre Le Sueur, of Paris.
Count Gröberg de Hemsö, of Florence.
Alexander de Brongniart, of Paris.
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Gerard Troost, M. D., of Nashville, Tennessee.
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Simon Greenleaf, of Massachusetts.

CONTENTS.

Page

Laws of the Society relating to the Transactions, ... iii
Officers of the Society for the Year 1853, ... iv
List of the Members of the Society elected since the Publication of the Ninth Volume, ... v
Obituary Notice, ... vii

ARTICLE I.

Astronomical Observations made at Hudson Observatory, Latitude 41° 14′ 42″.6, north, and Longitude 5*h*. 25*m*. 39*s*.5, west. Third Series. By Elias Loomis, Professor of Mathematics and Natural Philosophy in the University of the City of New York, ... 1

ARTICLE II.

Supplementary Note on the Construction and different Forms of the Magic Cyclovolute. By E. Nulty, . 17

ARTICLE III.

Materials towards a History of the Coleoptera Longicornia of the United States. By S. S. Haldeman, . 27

ARTICLE IV.

Description of New Fresh Water and Land Shells. By Isaac Lea, ... 67

ARTICLE V.

Memoir explanatory of a New Perpetual Calendar, Civil and Ecclesiastical, Julian and Gregorian. By William M'Ilvaine, ... 103

ARTICLE VI.

On the Corpus Luteum. By Charles D. Meigs, M. D., Mem. Am. Phil. Soc., Prof. of Mid. and Diseases of Women and Children in Jefferson Med. Coll., ... 131

ARTICLE VII.

Investigations which led to the detection of the coincidence between the computed place of the Planet Leverrier, and the observed place of a Star recorded by Lalande, in May, 1795. By Sears C. Walker, 141

ARTICLE VIII.

Memoir on the Reproduction of the Opossum. Didelphis Virginiana. By Charles D. Meigs, M. D., 155

ARTICLE IX.

On some of the Results of a Series of Experiments relative to different parts of Gunnery. By Captain Robert F. Stockton, of the United States Navy. Communicated by Professor Henry, 167

ARTICLE X.

Page
On the decomposing power of Water at High Temperatures. By Richard A. Tilghman, ... 173

ARTICLE XI.

On the Neutral Sulphate of the Oxide of Ethyle, and the products of its decomposition by water. By Charles M. Wetherill, Doctor of Philosophy, ... 177

ARTICLE XII.

De Calculo Eclipsium Besseliano Commentatio. Auctore Dr. Gustavo Adolpho Jahn. Lipsiæ, 1848, . 183

ARTICLE XIII.

On the Longitude of Washington, computed from the moon-culminations observed during the Years 1839—1842, inclusive. By Lieut. J. M. Gilliss, ... 211

ARTICLE XIV.

On the Accuracy of the Tabular Longitude of the Moon, to be obtained by the construction of New Lunar Tables. By Miers Fisher Longstreth, ... 225

ARTICLE XV.

On the Organization of the Genus Gregarina of Dufour. By Joseph Leidy, M. D., ... 235

ARTICLE XVI.

Some Observations on Nematoidea Imperfecta, and descriptions of three Parasitic Infusoriæ. By Joseph Leidy, M. D., ... 241

ARTICLE XVII.

Meteorological Observations, Napa-Keang, (Loo-Choo,) 1848—1849. Made by Dr. Bettelheim, . . 245

ARTICLE XVIII.

Descriptions of New Species of the Family Unionidæ. By Isaac Lea, ... 253

ARTICLE XIX.

Description of a New Genus (Basistoma) of the Family Melaniana, together with some New Species of American Melaniæ. By Isaac Lea, ... 295

ARTICLE XX.

Description of a New Species of Helix, from California, and a new Characteristic Form of certain American Colimaceæ. By Isaac Lea, ... 303

ARTICLE XXI.

On the Fossil Foot-Marks in the Red Sandstones of Pottsville, Schuylkill County, Pennsylvania. By Isaac Lea, ... 307

ARTICLE XXII.

Description of an extinct species of American Lion: FELIS ATROX. By Joseph Leidy, M. D., . . 319

ARTICLE XXIII.

A Memoir on the extinct Dicotylinæ of America. By Joseph Leidy, M. D., ... 323

ARTICLE XXIV.

Page

Chemical Examination of two Minerals from the neighbourhood of Reading, Pennsylvania; and on the occurrence of Gold in Pennsylvania. By Charles M. Wetherill, Ph. D., ... 345

ARTICLE XXV.

On a New Variety of Asphalt: (Melan-asphalt.) By Charles M. Wetherill, Ph. D., ... 353

ARTICLE XXVI.

On the Decomposition of the Alkaline Sulphates by Hydrochloric Acid and Chlorine. By R. A. Tilghman, 359

ARTICLE XXVII.

Notes on the Classification of the Carabidæ of the United States. By John L. Le Conte, M. D., . . . 363

ARTICLE XXVIII.

Revision of the Elateridæ of the United States. By John L. Le Conte, M. D., ... 405

Appendix, ... 505

Index of Genera, ... 508

TRANSACTIONS

OF THE

AMERICAN PHILOSOPHICAL SOCIETY.

ARTICLE I.

Astronomical Observations made at Hudson Observatory, Latitude 41° 14′ 42″.6, *north, and Longitude* 5*h*. 25*m*. 39*s*.5, *west. Third Series. By Elias Loomis, Professor of Mathematics and Natural Philosophy in the University of the City of New York. Read November* 15, 1844.

The general plan of observation has remained unchanged since the foundation of the observatory. The clock has not been stopped since January 31, 1840; but from the effects of dust and moisture, operating upon the pendulum and wheels, its rate has been somewhat affected, as will be seen from pages four to seven. The third spider line of the transit broke, April 20, 1841, and its place was supplied by the moveable micrometer line for a few days, until it could be replaced. July 14th, the fourth line broke, and the micrometer was substituted in its place. November 16th the micrometer broke; and December 28th, the second line also broke, leaving only three vertical lines. April 21, 1842, I undertook to replace all the lines, and, after some ineffectual attempts, succeeded in introducing fibres of silk from the cocoon. The lines, seven in number, were secured in their places by bees-wax, melted by a warm iron. These lines are a little coarser than the spider lines, are not quite so smooth, and are not perfectly straight. Nevertheless, by always observing transits on the same part of the lines, this last evil is mostly obviated. The equatorial intervals deduced from the transits of one hundred stars observed at all the wires, have been determined as follows:—

18.033; 18.537; 18.595; 19.123; 17.047; 18.679.

The intervals are quite unequal, but the reduction of the mean of all the wires to the central wire is no greater than when the instrument was first received, being 0s.107 × secant of the declination; positive above the pole, and negative below. I have therefore not attempted to change the position of the lines, as with a proper method of reduction the inequality of the intervals does not affect the accuracy of the observations. The pendulum of the clock appears to be somewhat under-compensated,—its daily rate being about one-second slower in summer than in winter.

I. LATITUDE OF HUDSON OBSERVATORY.

During the summer of 1841, I observed twenty-four culminations of Polaris; in 1842, fifteen culminations of Polaris, and four of β Ursæ Minoris; and in 1843, fifteen culminations of Polaris. They were all made in the usual way, alternately direct and by reflexion from mercury. The errors of the microscopes were found to be as follows:

	North Polar Distance.	A.	B.	C.	Mean.
1841, June,	358° 25′—30′	— 1″.5	+ 1″.3	+ 2″.2	+ 0″.67
	278 55—60	— 1 .9	+ 1 .1	+ 5 .0	+ 1 .40
July,	1 30—35	— 1 .6	+ 0 .2	+ 3 .1	+ 0 .56
	275 55—60	— 1 .9	+ 0 .3	+ 6 .0	+ 1 .47
1842, June,	358 25—30	— 0 .1	— 0 .4	+ 1 .0	+ 0 .20
	278 55—60	— 2 .1	+ 0 .5	+ 3 .3	+ 0 .58
July,	15 10—15	— 1 .7	+ 0 .8	+ 3 .3	+ 0 .82
	262 15—20	— 1 .9	+ 1 .0	+ 3 .3	+ 0 .80
1843, June,	358 25—30	— 0 .5	— 0 .2	+ 0 .7	+ 0 .00
	278 55—60	— 1 .6	+ 0 .7	+ 4 .1	+ 1 .10

The places of the stars are taken from the Nautical Almanac, and require corrections. In the Almanac for 1843, the declination of Polaris is corrected + 0″.50 to conform to the Greenwich observations, and in that for 1844, the correction is given + 0″.38. Accordingly, the declinations of the Almanac for 1841 and 1842 have been increased 0″.38, and those for 1843 diminished 0″.12. In the Almanac for 1842 the declination of β Ursæ Minoris is corrected — 0″.90, while the Almanac for 1844 gives the true correction — 0″.46. The declination for 1842 has accordingly been increased 0″.44.

The following are the results of the observations:

	Date.	Latitude.	No. of Obs.
Lower culmination of Polaris,	1841, May 14,	41° 14′ 44″.1	12
	15,	40 .7	9
	19,	42 .6	9
	20,	40 .8	9
	21,	39 .7	9
	27,	43 .7	9
	28,	42 .2	9
	29,	40 .3	9
	31,	42 .9	6
	June, 2,	40 .2	9
	3,	42 .5	9
	4,	43 .9	9
	5,	43 .0	9
	7,	43 .0	9
	8,	41 .7	5
	9,	40 .9	9

	Date.	Latitude.	No. of Obs
	June 10,	41° 14′ 43″.5	9
	11,	42 .3	8
	14,	40 .9	9
	16,	42 .5	9
Upper culmination of Polaris,	July 20,	41 .5	6
	21,	42 .5	7
	22,	41 .8	9
	23,	43 .3	9
Lower culmination of Polaris,	1842, May 12,	40 .1	13
	13,	44 .0	9
	14,	44 .5	9
	16,	42 .4	8
	24,	42 .4	7
	27,	42 .0	7
	30,	42 .4	7
	31,	43 .1	9
	June 1,	44 .3	7
	4,	41 .0	8
	6,	43 .0	8
	11,	40 .9	10
	13,	42 .7	10
	15,	42 .7	8
	17,	42 .7	5
Upper culmination of β Ursæ Minoris,	July 2,	43 .3	4
	6,	41 .5	6
	9,	44 .8	6
	11,	44 .9	6
Lower culmination of Polaris,	1843, May 15,	44 .1	9
	18,	44 .0	6
	19,	43 .2	7
	20,	43 .5	8
	24,	44 .4	6
	27,	44 .2	11
	29,	44 .7	12
	31,	40 .9	8
	June 1,	40 .5	8
	8,	42 .3	10
	12,	42 .6	8
	13,	42 .2	8
	16,	43 .0	6
	17,	43 .0	7
	19,	42 .3	7
Mean of fifty-eight culminations, ...		41 14 42 .7	

The result here obtained accords very well with the observations of 1840. If we apply to that result the correction of the Nautical Almanac, 0″.38, and take the mean of the observations of 1840, 1, 2, and 3, we have from sixty-three culminations of Polaris and four of β Ursæ Minoris the latitude 41° 14′ 42″.6, which is my final result.

II. OBSERVED TRANSITS OF THE MOON AND MOON CULMINATING STARS AT HUDSON OBSERVATORY.

The following list is a continuation of that given on pages 143—145 of Second Series. The mode of reduction is explained on page 142.

No.	Date.	Star.	No. Wires Obs.	Meridian Transit.	Clock's rate.
	1841.				
	March 2	C. Tauri	5	5h.43m. 2s.50	— 2s.02
		$\varkappa$ Aurigæ	5	6 4 57 .30	
126		Moon 1 L.	5	6 50 16 .86	
		δ Geminorum	5	7 10 20 .12	
		α^2 Geminorum	5	7 24 10 .24	
	March 3	δ Geminorum	5	7 10 18 .84	— 1 .75
		α^2 Geminorum	5	7 24 8 .02	
127		Moon 1 L.	5	7 55 57 .10	
		λ Cancri	5	8 10 45 .58	
		θ Cancri	5	8 22 12 .68	
	Mar. 29	ζ Tauri	5	5 28 9 .52	— 1 .69
128		Moon 1 L.	5	6 30 52 .92	
	Mar. 30	ζ Geminorum	5	6 54 40 .66	— 1 .07
129		Moon 1 L.	5	7 35 0 .42	
		6 Cancri	5	7 53 45 .28	
130	April 1	Moon 1 L.	5	9 32 42 .92	— 1 .23
		α Leonis	5	9 59 53 .24	
	April 2	o Leonis	5	9 32 37 .20	— 1 .48
		α Leonis	5	9 59 51 .48	
131		Moon 1 L.	5	10 26 28 .92	
		χ Leonis	5	10 56 46 .86	
	April 3	48 Leonis	5	10 26 26 .46	— 1 .58
		χ Leonis	5	10 56 45 .28	
132		Moon 1 L.	5	11 18 4 .44	
		υ Leonis	5	11 28 45 .00	
		β Virginis	5	11 42 21 .26	
	April 27	α^2 Geminorum	5	7 23 47 .88	— 1 .59
		β Geminorum	5	7 34 55 .96	
133		Moon 1 L.	5	8 17 11 .92	
		δ Cancri	5	8 35 0 .26	
	April 28	δ Cancri	5	8 34 58 .94	— 1 .32
		α^2 Cancri	5	8 49 7 .56	
134		Moon 1 L.	5	9 14 50 .94	
		ξ Leonis	5	9 22 42 .84	
		o Leonis	5	9 32 0 .12	
	May 27	α Leonis	5	9 59 40 .10	— 1 .20
		ϱ Leonis	3	10 24 12 .64	
135		Moon 1 L.	5	10 44 51 .24	
136	May 28	Moon 1 L.	5	11 34 53 .44	— 1 .39
		β Virginis	5	11 42 10 .06	
	May 29	β Virginis	5	11 42 8 .86	— 1 .20
137		Moon 1 L.	5	12 24 0 .92	
		γ' Virginis	5	12 33 20 .84	
	June 2	ι' Libræ	2	15 2 50 .11	— 1 .35
		γ' Libræ	5	15 26 18 .68	
138		Moon 1 L.	5	15 51 32 .90	
		β' Scorpii	5	15 55 52 .88	
		α Scorpii	5	16 19 20 .62	
139	June 4	Moon 2 L.	5	17 45 53 .92	— 1 .94
		γ^2 Sagittarii	5	17 55 12 .70	
		μ Sagittarii	5	18 3 52 .28	
140	June 6	Moon 2 L.	5	19 33 55 .12	— 1 .81
		57 Sagittarii	5	19 42 30 .16	
		c Sagittarii	5	19 52 25 .40	
	June 28	λ Virginis	5	14 10 25 .04	— 1 .93
141		Moon 1 L	5	14 40 31 .14	
		20 Libræ	5	14 51 41 .20	
		ι' Libræ	5	15 3 4 .76	
	June 29	20 Libræ	5	14 51 39 .10	— 2 .06
		ι' Libræ	5	15 3 2 .74	

No.	Date.	Star.	No. Wires Obs.	Meridian Transit.	Clock's rate.
	1841.				
142		Moon 1 L.	4	15h.34m.10s.60	
		b Scorpii	5	15 41 18 .18	
		δ Scorpii	5	15 50 49 .14	
	June 30	δ Scorpii	5	15 50 47 .14	— 2 .00
143		Moon 1 L.	5	16 29 20 .98	
		25 Scorpii	4	16 36 58 .64	
144	July 3	Moon 2 L.	5	19 16 24 .26	— 1 .84
		h^2 Sagittarii	5	19 26 46 .42	
		57 Sagittarii	5	19 42 41 .52	
	July 26	α^2 Libræ	5	14 42 11 .36	— 2 .00
145		Moon 1 L.	5	15 17 0 .30	
		π Scorpii	5	15 49 21 .12	
	July 28	σ Scorpii	5	16 11 33 .94	— 2 .15
		α Scorpii	5	16 19 41 .68	
146		Moon 1 L.	5	17 7 33 .70	
		θ Ophiuchi	5	17 12 17 .52	
		3 Sagittarii	5	17 37 36 .16	
	July 29	θ Ophiuchi	5	17 12 14 .88	— 2 .84
		3 Sagittarii	5	17 37 33 .12	
147		Moon 1 L.	5	18 2 59 .38	
		μ' Sagittarii	2	18 4 14 .95	
		λ Sagittarii	5	18 18 9 .08	
	Aug. 1	c Sagittarii	5	19 52 45 .94	— 2 .21
		β^2 Capricorni	5	20 11 57 .68	
148		Moon 1 L.	5	20 38 50 .04	
		Moon 2 L.*	5	20 40 59 .06	
		μ Aquarii	5	20 43 56 .96	
		ν Aquarii	5	21 0 48 .26	
	Aug. 2	μ Aquarii	5	20 43 55 .48	— 1 .52
		ν Aquarii	5	21 0 46 .70	
149		Moon 2 L.	5	21 28 20 .78	
		γ Capricorni	5	21 31 7 .52	
		μ Capricorni	5	21 44 28 .16	
	Aug. 3	γ Capricorni	5	21 31 5 .72	— 1 .80
		μ Capricorni	5	21 44 26 .36	
150		Moon 2 L.	5	22 14 0 .30	
		η Aquarii	5	22 26 59 .46	
	Aug. 5	ι Piscium	5	23 31 31 .12	— 1 .78
151		Moon 2 L.	5	23 43 32 .94	
		ω Piscium	5	23 50 53 .66	
	Oct. 18	α Scorpii	5	16 19 29 .32	— 2 .04
152		Moon 1 L.	5	16 57 38 .68	
153	Oct. 25	Moon 1 L.	5	22 51 15 .92	— 1 .54
		β Piscium	5	22 55 26 .64	
		γ Piscium	5	23 8 34 .88	
	Oct. 26	β Piscium	5	22 55 25 .14	— 1 .55
		γ Piscium	5	23 8 33 .28	
154		Moon 1 L.	5	23 36 51 .06	
		ω Piscium.	5	23 50 46 .60	
	Oct. 27	ω Piscium.	5	23 50 44 .88	— 1 .72
155		Moon 1 L.	5	0 23 52 .02	
		δ Piscium.	5	0 40 2 .06	
	Nov. 22	λ Aquarii	4	22 44 19 .18	— 1 .27
		β Piscium	4	22 55 47 .13	
156		Moon 1 L.	4	23 16 30 .24	
		$\varkappa'$ Piscium	4	23 18 47 .18	
		ι Piscium	4	23 31 46 .56	
	Nov. 23	$\varkappa'$ Piscium	4	23 18 45 .50	— 1 .59
		ι Piscium	4	23 31 45 .06	
157		Moon 1 L.	4	0 2 10 .09	

* Slightly deficient.

No.	Date.	Star.	No. Wires Obs.	Meridian Transit.	Clock's rate.
	1841.				
	Nov. 23	d Piscium	4	0h.12m.24s.11	
	1842.				
	April 20	α Leonis	3	9 59 34 .36	— 2s.36
158		Moon 1 L	3	10 31 36 .90	
	April 21	34 Sextantis	7	10 34 3 .01	— 2 .73
		d Leonis	7	10 51 59 .30	
159		Moon 1 L.	7	11 25 49 .51	
		ν Leonis	4	11 28 27 .23	
		β Virginis	7	11 42 3 .53	
	April 24	α Virginis	7	13 16 13 .74	— 1 .17
		x Virginis	7	13 40 39 .16	
160		Moon 1 L.*	7	14 13 37 .01	
		Moon 2 L.	7	14 15 59 .17	
		α² Libræ	7	14 41 30 .53	
		20 Libræ	7	14 54 11 .59	
	April 28	e² Ophiuchi	7	17 20 51 .63	— 3 .83
		4 Sagittarii	7	17 49 13 .69	
161		Moon 2 L.	7	18 15 27 .14	
		λ Sagittarii	5	18 17 17 .86	
		τ Sagittarii	7	18 44 32 .03	
	May 20	η Virginis	5	12 11 42 .43	— 3 .07
162		Moon 1 L.	7	12 53 51 .86	
		α Virginis	7	13 16 45 .57	
	May 30	β Aquarii	7	21 22 35 .41	— 3 .09
		δ Capricorni	4	21 37 40 .20	
163		Moon 2 L.	7	22 5 56 .19	
164	June 13	Moon 1 L.	7	9 57 6 .89	— 2 .57
		α Leonis	7	9 59 35 .01	
165	June 17	Moon 1 L.	2	13 30 17 .36	— 2 .82
		x Virginis.	5	13 40 44 .69	
166	June 19	Moon 1 L.	7	15 21 7 .19	— 3 .90
		b Scorpii	7	15 40 18 .49	
		δ Scorpii	7	15 50 19 .53	
	June 20	b Scorpii	7	15 40 11 .99	— 3 .28
		δ Scorpii	7	15 50 16 .46	
		α Scorpii	7	16 18 59 .67	
167		Moon 1 L.	7	16 23 31 .43	
	June 21	α Scorpii	4	16 18 55 .96	— 3 .71
		η Ophiuchi	7	17 0 31 .80	
168		Moon 1 L.	7	17 23 14 .86	
		3 Sagittarii	7	17 36 49 .36	
		4 Sagittarii	7	17 49 21 .14	
	June 24	h² Sagittarii	7	19 27 6 .60	— 3 .32
		57 Sagittarii	7	19 43 2 .14	
169		Moon 2 L.	7	20 12 47 .16	
	June 28	λ Aquarii	4	22 44 8 .99	— 3 .78
170		Moon 2 L.	7	23 16 50 .90	
	July 15	α Virginis	7	13 16 36 .24	— 3 .39
171		Moon 1 L.	7	14 9 22 .84	
	July 16	α² Libræ	7	14 41 49 .80	— 3 .57
172		Moon 1 L.	7	15 6 21 .21	
		x Libræ	7	15 32 32 .04	
		b Scorpii	7	15 41 10 .23	
173	July 17	Moon 1 L.	7	16 4 45 .57	— 3 .31
		τ Scorpii	7	16 11 13 .17	
		α Scorpii	7	16 19 21 .44	
	July 21	π Sagittarii	7	18 59 15 .80	— 3 .29
		h² Sagittarii	7	19 26 29 .80	
174		Moon 1 L.	7	19 51 8 .07	
		Moon 2 L.†	7	19 53 20 .74	

No.	Date	Star.	No. Wires Obs.	Meridian Transit.	Clock's rate.
	1842.				
		α² Capricorni	7	20h. 8m.42s.03	
		ζ Capricorni	7	20 19 15 .34	
175	Aug. 13	Moon 1 L.	7	15 46 28 .59	— 2s.69
		β¹ Scorpii	7	15 55 38 .03	
		α Scorpii	7	16 19 6 .57	
	Aug. 16	γ² Sagittarii	5	17 54 54 .55	— 2 .74
		μ¹ Sagittarii	7	18 3 33 .86	
176		Moon 1 L.	7	18 40 13 .49	
		σ Sagittarii	7	18 44 43 .01	
		π Sagittarii	7	18 59 36 .49	
	Aug. 19	ν Capricorni	7	20 30 8 .29	— 3 .43
		μ Aquarii	7	20 43 12 .66	
177		Moon 1 L.	7	21 12 44 .71	
		β Aquarii	7	21 22 19 .27	
	Aug. 20	ι Capricorni	7	21 13 28 .07	— 3 .74
		β Aquarii	7	21 23 15 .53	
178		Moon 1 L.	7	21 59 34 .70	
		Moon 2 L.‡	7	22 1 38 .09	
		ϑ Aquarii	7	22 8 30 .87	
		ζ Aquarii	7	22 20 42 .67	
	Aug. 21	θ Aquarii	4	22 8 28 .35	— 2 .51
		ζ Aquarii	7	22 20 40 .17	
179		Moon 2 L.	7	22 46 0 .97	
		β Piscium	7	22 55 18 .49	
	Aug. 22	β Piscium	7	22 55 15 .47	— 3 .02
180		Moon 2 L.	7	23 29 50 .54	
		ω Piscium	7	23 51 7 .04	
	Aug. 23	ι Piscium	7	23 31 42 .39	— 2 .31
		ω Piscium	7	23 51 4 .73	
181		Moon 2 L.	7	0 44 0 .66	
	Aug. 27	δ Arietis	7	3 2 17 .04	— 2 .79
182		Moon 2 L.	3	3 31 48 .89	
	Aug. 28	ζ Tauri	7	3 37 43 .31	— 3 .48
		A¹ Tauri	6	3 54 59 .10	
183		Moon 2 L.§	4	4 29 38 .52	
	Sept. 12	4 Sagittarii	7	17 50 2 .39	— 3 .17
184		Moon 1 L.	7	18 23 0 .44	
		σ Sagittarii	7	18 45 24 .16	
		ο Sagittarii	7	18 55 5 .83	
	Sept. 13	σ Sagittarii	7	18 45 17 .99	— 2 .94
		ο Sagittarii	7	18 55 3 .44	
185		Moon 1 L.	7	19 17 46 .03	
		h¹ Sagittarii	7	19 26 55 .56	
	Sept. 16	ζ Capricorni	7	21 6 42 .06	— 2 .71
		β Aquarii	7	21 22 56 .64	
186		Moon 1 L.	7	21 44 28 .64	
		ε Aquarii	7	21 57 36 .60	
		θ Aquarii	3	22 8 12 .58	
	Sept. 17	ε Aquarii	4	21 57 34 .21	— 2 .[illegible]
		θ Aquarii	7	22 8 9 .90	
187		Moon 1 L.	7	22 29 15 .05	
	Sept. 18	x¹ Piscium	4	22 52 0 .[illegible]	— [illegible] .31
188		Moon 1 L.	7	23 13 16 .57	
		x Piscium	4	23 18 27 .7[illegible]	
		[illegible] Piscium	4	23 31 57 .[illegible]	
	Sept. 19	[illegible] Piscium	7	23 18 25 .[illegible]	— [illegible]
		[illegible] Piscium	7	[illegible] 31 54 .77	
189		Moon 2 L.	7	23 50 28 .40	
		l Piscium	7	0 12 1 .79	
	Sept. 23	[illegible] Arietis	7	[illegible]	— [illegible]

* Somewhat deficient. † Slightly deficient. ‡ Both limbs apparently [illegible]. § [illegible]

No.	Date.	Star.	No. Wires Obs.	Meridian Transit.	Clock's rate.
	1842.				
		ϵ Arietis	7	2h.19m.10s.10	
190		Moon 2 L.	7	3 13 59 .60	
		γ Tauri	7	3 37 31 .60	
	Sept. 24	g Arietis*	7	3 14 25 .09	—1s.73
		η Tauri	7	3 37 32 .87	
191		Moon 2 L.	7	4 9 52 .89	
		ν' Tauri	7	4 16 17 .90	
		τ Tauri	7	4 32 12 .61	
	Sept. 26	β Tauri	7	5 15 40 .64	— 2 .14
		B Tauri	7	5 38 41 .04	
192		Moon 2 L.	7	6 8 52 .04	
		μ Geminorum	7	6 12 45 .50	
		ϵ Geminorum	7	6 33 33 .69	
	Sept. 27	μ Geminorum	4	6 12 43 .24	— 2 .26
193		Moon 2 L.	7	7 9 39 .49	
		β Geminorum	7	7 34 57 .03	
	Sept. 28	β Geminorum	5	7 34 54 .78	— 2 .25
194		Moon 2 L.	7	8 9 42 .16	
195	Oct. 10	Moon 1 L.	7	18 58 6 .97	— 1 .74
		π Sagittarii	6	19 0 17 .59	
		h^2 Sagittarii	7	19 27 0 .84	
	Oct. 11	π Sagittarii	7	19 0 16 .13	— 1 .45
		h^2 Sagittarii	7	19 26 59 .40	
196		Moon 1 L.	7	19 51 32 .04	
		β^2 Capricorni	7	20 12 1 .97	
		ξ Capricorni	7	20 19 44 .89	
	Oct. 12	β^2 Capricorni	7	20 12 0 .21	— 1 .69
		ξ Capricorni	7	20 19 43 .24	
197		Moon 1 L.	7	20 41 32 .41	
		θ Capricorni	7	20 56 56 .31	
		ζ Capricorni	7	21 6 52 .64	
	Oct. 13	θ Capricorni	7	20 56 54 .87	— 1 .67
		ζ Capricorni	7	21 6 50 .74	
198		Moon 1 L.	7	21 28 45 .56	
		μ Capricorni	7	21 44 31 .73	
	Oct. 15	γ Aquarii	7	22 13 17 .63	— 1 .50
		η Aquarii	7	22 27 2 .49	
199		Moon 1 L.	7	22 58 14 .21	
		γ Piscium	7	23 8 46 .63	
		$\varkappa'$ Piscium	7	23 18 37 .99	
	Oct. 16	γ Piscium	7	23 8 44 .77	— 1 .84
		$\varkappa'$ Piscium	7	23 18 36 .17	
200		Moon 1 L.	7	23 42 21 .96	
		ω Piscium	7	23 50 57 .89	
	Oct. 23	ι Tauri	7	4 53 14 .63	— 1 .46
		β Tauri	7	5 15 54 .57	
201		Moon 2 L.	7	5 50 25 .01	
		H Geminorum	7	5 51 6 .01	
		μ Geminorum	7	6 12 58 .90	
	Oct. 25	ζ Geminorum	6	6 51 15 .13	— 1 .77
		δ Geminorum	7	7 10 12 .24	
202		Moon 2 L.	7	7 49 9 .80	
		a' Cancri	7	7 56 27 .00	
		θ Cancri	7	8 22 4 .99	
	Oct. 26	a' Cancri	7	7 56 25 .63	— 1 .71
		θ Cancri	7	8 22 2 .93	
203		Moon 2 L.	7	8 46 31 .41	
		a^2 Cancri	7	8 49 18 .46	
	Oct. 27	a^2 Cancri	7	8 49 16 .73	— 1 .73
204		Moon 2 L.	7	9 42 21 .46	
		α Leonis	7	9h.59m.22s.96	
	Nov. 13	ι Piscium	7	23 31 44 .99	—1s.93
		ω Piscium	7	23 51 7 .81	
205		Moon 1 L.	7	0 10 1 .96	
	Nov. 24	o Leonis	5	9 32 19 .24	— 1 .62
		π Leonis	7	9 51 27 .77	
206		Moon 2 L.	7	10 18 58 .06	
	Nov. 25	ϱ Leonis	7	10 24 3 .41	— 1 .72
		34 Sextantis	7	10 34 1 .43	
207		Moon 2 L.	7	11 12 12 .93	
	Dec. 12	δ Piscium	5	0 39 37 .20	— 1 .33
		ϵ Piscium	7	0 53 53 .20	
208		Moon 1 L.	7	1 22 36 .04	
		β Arietis	1	1 45 3 .01	
	Dec. 17	β Tauri	7	5 16 21 .89	— 1 .49
		ζ Tauri	7	5 28 15 .11	
209		Moon 2 L.	7	6 8 42 .69	
		μ Geminorum	7	6 13 27 .03	
		ϵ Geminorum	7	6 34 15 .49	
	Dec. 23	p^1 Leonis	7	11 5 35 .09	— 1 .07
		e Leonis	7	11 22 9 .10	
210		Moon 2 L.	7	11 49 41 .99	
		η Virginis	7	12 11 43 .51	
	1843.				
	Jan. 9	η Piscium	7	1 22 35 .39	— 1 .08
211		Moon 1 L.	7	1 50 22 .66	
	Jan. 21	ψ Virginis	7	12 45 26 .01	— 1 .56
212		Moon 2 L.†	5	13 21 36 .65	
	Jan. 24	δ Scorpii	7	15 50 11 .59	— 2 .33
213		Moon 2 L.	7	16 17 55 .00	
		α Scorpii	3	16 18 55 .21	
	Jan. 25	α Scorpii	7	16 18 53 .40	— 1 .81
214		Moon 2 L.	7	17 18 23 .99	
	Feb. 9	ν' Tauri	7	4 16 43 .63	— 1 .13
		τ Tauri	7	4 32 38 .30	
215		Moon 1 L.	7	5 6 2 .50	
		β Tauri	7	5 16 11 .04	
		ζ Tauri	7	5 28 4 .50	
	Mar. 11	g Geminorum	7	7 36 20 .96	— 1 .37
216		Moon 1 L.	7	7 38 30 .10	
		ζ Cancri	7	8 2 31 .19	
	Mar. 13	a^2 Cancri	7	8 49 10 .60	— 1 .15
		$\varkappa$ Cancri	7	8 58 31 .27	
217		Moon 1 L.	7	9 35 43 .60	
218	April 7	Moon 1 L.	7	7 14 47 .81	— 2 .72
		$\varkappa$ Geminorum	7	7 34 27 .11	
	April 10	α Leonis	7	9 59 23 .43	— 2 .11
219		Moon 1 L.	7	10 4 28 .19	
		ϱ Leonis	7	10 23 56 .10	
	April 11	α Leonis	7	9 59 21 .24	— 2 .19
220		Moon 1 L.	7	11 0 31 .11	
	April 12	τ Leonis	7	11 19 10 .90	— 1 .77
		v Leonis	7	11 28 13 .49	
221		Moon 1 L.	7	11 57 33 .93	
		γ Virginis	7	12 11 11 .86	
		η Virginis	7	12 25 0 .07	
	May 11	η Virginis	7	12 25 51 .77	— 3 .08
		ψ Virginis	7	12 46 22 .93	
222		Moon 1 L.	7	13 27 10 .60	
		x Virginis	7	13 41 32 .26	

* Indistinctly seen.

† Seen through flying clouds.

No.	Date.	Star.	No. Wires Obs.	Meridian Transit.	Clock's rate
	1843.				
	June 8	53 Virginis	7	13h. 3m. 40s.71	—2s.71
		α Virginis	7	13 16 53 .66	
223		Moon 1 L.	7	14 1 19 .60	
		λ Virginis	7	14 10 35 .73	
	June 11	α Scorpii	7	16 19 37 .71	—2 .79
		τ Scorpii	7	16 25 57 .77	
224		Moon 1 L.	7	17 12 36 .77	
		Moon 2 L.'	7	17 15 5 .30	
	June 17	30 Aquarii	7	21 54 31 .50	—2 .63
		γ Aquarii	7	22 13 6 .21	
225		Moon 2 L.	7	22 41 59 .19	
	July 2	α Leonis	6	9 59 48 .38	—3 .32
226		Moon 1 L.	7	10 56 33 .17	
	July 7	20 Libræ	7	14 51 31 .40	—2 .24
227		Moon 1 L.	7	15 42 4 .49	
		δ' Scorpii	7	15 55 56 .97	
		α Scorpii	7	16 19 25 .61	
	July 8	α Scorpii	7	16 19 22 .77	—2 .84
228		Moon 1 L	7	16 45 28 .39	
		η Ophiuchi	7	17 0 57 .69	
		θ Ophiuchi	7	17 11 57 .30	
229	July 16	Moon 2 L.	7	23 53 11 .96	—2 .32
		E' Piscium	7	0 1 12 .06	
230	July 21	Moon 2 L.	7	3 59 22 .76	—2 .39
		α Tauri	7	4 26 56 .09	
231	Aug. 3	Moon 1 L.	7	15 22 40 .96	—1 .92
		δ Scorpii	7	15 50 33 .81	
232	Aug. 5	Moon 1 L.	7	17 26 52 .56	—1 .95
		41 Sagittarii	7	17 49 39 .31	
233	Aug. 14	Moon 2 L.	7	1 7 22 .96	—3 .17
		τ Piscium	7	1 23 2 .06	
234	Aug. 15	Moon 2 L.	7	1 51 48 .84	—2 .89
		θ' Arietis	7	2 9 17 .93	
		ψ Arietis	7	2 22 6 .16	
235	Sept. 15	Moon 2 L.	7	5 3 43 .17	—2 .99
		β Tauri	7	5 15 13 .27	
		ζ Tauri	7	5 27 36 .71	
	Sept. 16	β Tauri	7	5 15 40 .10	—3 .22
		ζ Tauri	7	5 27 33 .47	
236		Moon 2 L.	7	5 59 52 .50	
		μ Geminorum	7	6 12 15 .27	
237	Sept. 29	Moon 1 L.	7	17 50 5 .61	—2 .81
		μ' Sagittarii	6	18 3 59 .67	
		λ Sagittarii	7	18 17 51 .11	
238	Oct. 2	Moon 1 L.	7	20 38 59 .47	—2 .88
		α Aquarii	3	20 43 39 .72	
239	Oct. 3	Moon 1 L.	7	21 28 31 .09	—2 .18
		δ Capricorni	5	21 37 50 .38	
		30 Aquarii	7	21 51 28 .79	
240	Oct. 4	Moon 1 L.	7	22 15 49 .01	—1 .79
		γ Piscium	7	23 8 28 .17	
		χ' Piscium	7	23 18 19 .61	
	Oct. 5	γ Aquarii	7	22 12 57 .21	—1 .75
		η Aquarii	7	22 26 41 .69	
241		Moon 1 L.	7	23 1 38 .30	
		γ Piscium	7	23 8 26 .41	
		χ' Piscium	7	23 18 17 .83	
	Oct. 10	ε Arietis	7	2 29 3 .99	—3 .03
242		Moon 2 L.	7	2 58 46 .21	

No.	Date	Star	No. Wires Obs.	Meridian Transit.	Clock's rate
	1843.				
		δ Arietis	2	3h. 1m. 18s.92	
		ζ Arietis	7	3 14 12 .37	
	Oct. 16	χ Geminorum	5	7 34 44 .79	—3 .15
243		Moon 2 L.	7	8 25 36 .39	
	Oct. 30	ε Capricorni	7	20 30 11 .41	—2 .89
		α Aquarii	7	20 43 18 .69	
244		Moon 1 L.	7	21 12 6 .66	
		β Aquarii	7	21 22 25 .37	
		λ Capricorni	7	21 37 13 .21	
	Oct. 31	β Aquarii	5	21 22 23 .09	—2 .26
		λ Capricorni	7	21 37 10 .96	
245		Moon 1 L.	7	22 0 17 .71	
		ψ Aquarii	7	22 7 38 .99	
		ζ Aquarii	7	22 19 51 .10	
	Dec. 3	β Arietis	7	1 45 39 .24	—2 .04
246		Moon 1 L.	7	2 23 3 .99	
		λ Arietis	7	2 29 35 .26	
	Dec. 4	ε Arietis	2	2 29 31 .21	—2 .19
		ι Arietis	7	2 49 53 .57	
247		Moon 1 L.	7	3 13 58 .26	
248	Dec. 13	Moon 2 L.	7	11 18 51 .17	—2 .10
		ε Leonis	7	11 21 33 .37	
		β Virginis	7	11 41 46 .54	
	1844.				
249	Jan. 27	Moon 1 L.	7	2 33 36 .29	—1 .99
		ι Arietis	7	2 50 19 .61	
		δ Arietis	7	3 2 44 .63	
250	Feb. 10	Moon 2 L.	7	15 30 9 .96	—1 .93
		δ Scorpii	7	15 50 14 .10	
		δ' Scorpii	7	15 55 59 .40	
251	Feb. 24	Moon 1 L.	6	2 2 39 .40	—2 .28
		α Persei	7	3 12 22 .01	
	Feb. 27	β Tauri	7	5 15 29 .46	—2 .01
252		Moon 1 L.	7	5 42 16 .70	
		η Geminorum	7	6 1 31 .44	
		μ Geminorum	7	6 12 35 .01	
	Mar. 10	θ Ophiuchi	7	17 12 2 .50	—2 .75
253		Moon 2 L.	7	17 17 19 .73	
254	May 23	Moon 1 L.	5	9 7 35 .11	—2 .08
		α Hydræ	3	9 19 54 .51	
	May 27	β Virginis	7	11 12 19 .39	—3 .02
		γ Virginis	2	12 11 40 .33	
255		Moon 1 L.	7	12 37 4 .16	
	May 28	ζ Virginis	7	12 45 56 .89	—3 .06
		53 Virginis	6	13 3 28 .11	
256		Moon 1 L.	7	13 35 33 .07	
		κ Virginis	7	13 41 6 .61	
257	June 21	Moon 1 L.	7	13 11 4 .39	—2 .60
		α Virginis	7	13 16 29 .56	
258	July 23	Moon 1 L.	7	14 49 5 .30	—2 .61
		β Libræ	2	15 7 59 .46	
		α Scorpii	7	15 35 57 .00	
	July 24	δ Scorpii	4	15 50 27 .60	—2 .50
259		Moon 1 L.	7	15 51 43 .77	
		δ Scorpii	7	15 55 44 .64	
		α Scorpii	7	16 19 12 .30	
	Aug. 4	β Arietis	7	1 45 58 .97	—2 .60
		ι Arietis	7	1 58 20 .11	
260		Moon 2 L.	7	2 8 37 .21	

III. OBSERVED OCCULTATIONS OF FIXED STARS AT HUDSON OBSERVATORY.

No.	Date.	Star.	Immersion. Sidereal Time.	Emersion. Sidereal Time.	Remarks.
1	1841, June 2,	π Scorpii	$12h.43m.28s.32$	$14h.\ 1m.20s.90$	Im. pretty good obs.; Em. tolerable obs.
2	1842, June 20,	α Scorpii	12 57 17 .82	13 22 16 .89	Im. and Em. both good.

IV. LONGITUDE OF HUDSON OBSERVATORY.

Having obtained a few corresponding observations of the moon from European observatories, I have derived some determinations of my longitude. The results are exhibited in the following tables.

GREENWICH AND HUDSON.

MOON'S *FIRST* LIMB.

Date.	Observed increase of A. R.	Computed Longitude.	Date.	Observed increase of A. R.	Computed Longitude.
1839, Jan. 24,	$14m.\ 4s.17$	$5h.25m.41s.7$	1840, April 13,	$10m.23s.62$	$5h.25m.41s.2$
March 23,	13 5 .77	27 .7	15,	10 24 .54	46 .9
24,	12 5 .31	29 .3	June 8,	10 17 .12	48 .5
25,	11 10 .57	36 .0	13,	12 20 .69	40 .8
27,	9 58 .79	36 .7	July 9,	11 43 .19	44 .1
April 20,	12 37 .40	39 .7	13,	12 23 .70	29 .7
24,	9 45 .90	49 .8	August 4,	11 8 .95	33 .5
25,	9 41 .75	40 .1	5,	11 36 .33	40 .0
26,	9 52 .07	30 .1	8,	12 38 .03	52 .6
May 25,	10 40 .19	35 .1	September 6,	12 17 .95	41 .3
26,	11 22 .93	33 .3	7,	11 55 .40	46 .3
June 24,	12 42 .52	49 .8	October 6,	11 13 .38	42 .0
July 22,	13 5 .56	52 .2	7,	11 3 .42	41 .5
24,	13 33 .39	36 .9	November 2,	11 6 .46	37 .9
25,	13 12 .95	29 .7	3,	10 52 .22	46 .3
August 20,	13 30 .53	48 .2	December 2,	10 36 .69	32 .0
21,	13 23 .44	36 .0	1841, April 2,	11 55 .91	38 .6
23,	12 31 .57	39 .9	3,	11 32 .68	29 .8
October 14,	12 55 .88	48 .3	27,	13 38 .25	40 .0
15,	12 45 .20	43 .7	28,	12 40 .91	42 .1
16,	12 25 .90	45 .1	May 27,	11 34 .32	47 .4
November 16,	11 41 .69	43 .3	28,	11 11 .55	48 .5
18,	13 7 .59	36 .7	June 30,	12 35 .17	48 .8
19,	14 14 .89	27 .1	July 26,	12 14 .82	40 .3
1840, March 13,	13 10 .95	38 .0	28,	12 36 .77	35 .6
April 8,	14 32 .99	39 .3	October 25,	10 13 .69	32 .7
11,	11 25 .72	28 .5			

Mean of fifty-three determinations from moon's first limb, $5h.\ 25m.\ 39s.9$. Mean difference, $\pm\ 5s.6$. Probable error, $\pm\ 0s.65$.

MOON'S *SECOND* LIMB.

1839, July 28,	$11m.43s.49$	$5h.25m.44s.2$	1840, Sept. 13,	12 4 .58	$5h.25m.41s.6$
August 2,	13 50 .37	42 .1	17,	15 7 .98	46 .4
25,	11 54 .67	50 .8	October 12,	13 54 .71	35 .6
October 24,	15 29 .07	31 .3	13,	14 50 .46	28 .9
November 22,	15 53 .16	31 .9	November 10,	15 43 .89	44 .3
1840, April 19,	12 13 .26	50 .6	16,	11 11 .17	42 .9
July 15,	11 28 .63	46 .7	1841, June 4,	12 39 .28	47 .7
16,	11 2 .48	41 .8	6,	11 46 .17	39 .7
August 4,	10 51 .92	40 .0	July 3,	11 56 .99	48 .5
September 12,	11 28 .00	40 .0			

Mean of nineteen determinations from moon's second limb, $5h.\ 25m.\ 42s.0$. Mean difference $\pm\ 4s.7$. Probable error, $\pm\ 0.92$.

Mean of seventy-two determinations from both limbs, allowing double weight to the observations of the first limb, $5h.\ 25m.\ 40s.6$.

CAMBRIDGE AND HUDSON.

MOON'S *FIRST* LIMB.

Date.	Observed increase of A. R.	Computed Longitude.	Date.	Observed increase of A. R.	Computed Longitude.
1838, Nov. 29,	13*m*.49*s*.80	5*h*.25*m*.65*s*.9	1839, June 24,	12*m*.43*s*.41	5*h*.25*m*.73*s*.5
1839, Jan. 24,	14 5 .29	63 .9	July 18,	10 7 .18	50 .5
Feb. 19,	13 21 .47	56 .2	22,	13 6 .54	76 .7
21,	14 19 .39	52 .9	August 20,	13 31 .28	66 .1
March 24,	12 6 .33	56 .6	21,	13 24 .32	57 .3
25,	11 11 .72	69 .5	22,	13 1 .07	52 .2
27,	9 59 .35	55 .0	23,	12 32 .72	69 .7
April 19,	13 47 .26	61 .7	October 14,	12 56 .68	68 .5
20,	12 38 .50	67 .9	15,	12 46 .23	70 .0
21,	11 33 .50	61 .2	16,	12 26 .82	69 .2
24,	9 46 .50	69 .7	18,	11 55 .69	73 .7
25,	9 42 .28	57 .9	20,	12 16 .50	58 .9
27,	10 17 .24	67 .9	November 16,	11 42 .63	69 .6
May 25,	10 40 .82	54 .1	18,	13 8 .46	58 .5
26,	11 23 .66	54 .3			

Mean of twenty-nine determinations from moon's *first* limb, 5*h*. 26*m*. 32*s*. Mean difference, ± 6*s*.6. Probable error, ± 1*s*.0.

MOON'S *SECOND* LIMB.

1839, August 2,	13*m*.51*s*.18	5*h*.25*m*.62*s*.1	October 24,	15*m*.30*s*.45	5*h*.25*m*.63*s*.9
25,	11 55 .11	62 .8	November 22,	15 54 .44	57 .8

Mean of four determinations from moon's second limb, 5*h*.26*m*.1*s*.7. Mean difference ±1*s*.9. Probable error, ±0.8.

Mean of thirty-three determinations from both limbs, allowing double weight to the first limb, 5*h*.26*m*.2*s*.7.

Longitude of Cambridge, — 23*s*.5. Longitude of Hudson, from Greenwich, 5*h*.25*m*.39*s*.2.

OXFORD AND HUDSON.

MOON'S *FIRST* LIMB.

1840, April 9,	13*m*.15*s*.90	5*h*.20*m*.40*s*.9	October 7,	10*m*.52*s*.84	5*h*.20*m*.30*s*.0
June 8,	10 7 .63	48 .0	November 2,	10 55 .81	26 .7
13,	12 9 .30	39 .3	6,	11 27 .08	34 .1
July 13,	12 12 .16	27 .4	*9,	14 34 .28	25 .2
August 8,	12 25 .86	38 .8	December 1,	10 21 .63	24 .0
September 7,	11 43 .90	33 .3	2,	10 26 .76	26 .9
October 6,	11 2 .62	30 .7			

Mean of 13 determinations from moon's *first* limb, 5*h*. 20*m*. 32*s*.7. Mean difference, ±5*s*.9. Probable error ±1*s*.4.

MOON'S *SECOND* LIMB

1840, July 15,	11*m*.17*s*.68	5*h*.20*m*.37*s*.4	November 9,	11*m*.36*s*.88	5*h*.20*m*.52*s*.0
August 14,	10 42 .12	46 .3	10,	15 29 .47	44 .5
October 12,	13 42 .08	37 .6			

Mean of 5 determinations from moon's second limb, 5*h*.20*m*.43*s*.5. Mean difference, ±1*s*.9. Probable error, ±1*s*.0

Mean of eighteen determinations from both limbs, 5*h*. 20*m*. 36*s*.3.

Longitude of Oxford, + 5*m*. 1*s*.5. Longitude of Hudson, from Greenwich, 5*h*. 25*m*. 37*s*.8.

* The correction for defective illumination of the moon's first limb is — 0*s*.29, computed from the formula, moon's radius × versed sine of θ; where θ is the difference of A. R. of the sun and moon, diminished by 12*h*., and multiplied by the cosine of the sun's declination.

EDINBURGH AND HUDSON.

MOON'S *FIRST* LIMB.

Date.	Observed increase of A. R.	Computed Longitude.	Date.	Observed increase of A. R.	Computed Longitude.
1838, Sept. 29,	12*m*.54*s*.61	5*h*.12*m*.44*s*.5	1839, April 24,	9*m*.22*s*.72	5*h*.12*m*.54*s*.5
October 1,	12 7 .75	49 .5	26,	9 29 .67	65 .2
27,	12 10 .52	60 .9	27,	9 52 .67	61 .0
November, 29,	13 16 .35	48 .6	May 25,	10 15 .13	44 .0
1839, Jan. 24,	13 13 .41	53 .0	June 20,	9 37 .27	60 .0
February, 19,	12 49 .33	44 .6	August 20,	12 58 .66	56 .1
March 22,	13 27 .34	49 .8	October 17,	11 37 .59	48 .9
23,	12 34 .94	44 .7	18,	11 27 .00	66 .1
24,	11 36 .82	45 .5	20,	11 46 .87	45 .2
25,	10 44 .29	53 .0	November 16,	11 14 .42	57 .8
April 18,	14 9 .10	59 .6	17,	11 45 .73	45 .0
19,	13 13 .75	52 .8	19,	13 42 .22	50 .6
21,	11 5 .21	50 .0			

Mean of 25 determinations from moon's first limb, 5*h*. 12*m*. 52*s*.4. Mean difference, ±5*s*.7. Probable error, ±1*s*.0.

MOON'S *SECOND* LIMB.

1839, July 4,	12*m*. 0*s*.02	5*h*.13*m*. 3*s*.2	1839, Aug. 2,	13*m*.18*s*.33	5*h*.13*m*. 5*s*.9

Mean of two determinations from moon's second limb, 5*h*.13*m*.4*s*.5. Mean difference, ±1*s*.3. Probable error ±0.8.

Mean of twenty-seven determinations from both limbs, 5*h*. 12*m*. 56*s*.4.

Longitude of Edinburgh, + 12*m*. 43*s*.0. Longitude of Hudson, from Greenwich, 5*h*. 25*m*. 39*s*. 4.

RESULTS.

Longitude of Hudson, from 72 Greenwich observations, 5*h*. 25*m*. 40*s*.6

"	"	33 Cambridge	"	39 .2
"	"	18 Oxford	"	37 .8
"	"	27 Edinburgh	"	39 .4

Mean of one hundred and fifty determinations, allowing double weight to the Greenwich observations, 5*h*. 25*m*. 39*s*.5.

When all the European observations up to the present time have been published, we may expect to obtain many new determinations of longitude. At present, I assume, for the position of Hudson observatory, Northern Latitude, 41° 14′ 42″.6; Western Longitude, from Greenwich, 5*h*. 25*m*. 39*s*.5.

The transit instrument is 1399 feet north, and 919 feet east of what is reported to be the centre of Hudson township. We have, then, for the centre of the township, North Latitude, 41° 14′ 28″.9; West Longitude, 5*h*. 25*m*. 38*s*.7, a result of some importance to geography, and differs sensibly from the position assigned on most maps.

V. OBSERVATIONS OF COMETS.

1. *Encke's Comet.*

Encke's comet was observed in 1842, on the evenings of March 28, 30, 31; April 1, 4, 5, 7, 9, and 11. The mode of observation consisted in observing the times of ingress and egress of the comet, and one or more stars of comparison. For this purpose, I employed a positive eye-piece, with a magnifying power of fifty-eight, having five parallel and equidistant spider lines, crossed by as many others at right angles. The diameter of the

field was determined to be 1976 .65. The same eye-piece has been employed in all the cometary observations.

The following table shows the true right ascensions and declinations of the stars of comparison for the dates of observation, according to several authorities. Lalande's observations are found in the Histoire Celeste, pp. 34, 38, 192 and 194. Bessel's are from Zones 332, 394, and 506. I have also observed all the stars on the meridian with the transit circle, most of them repeatedly, and the results are given below. The numbers contained in the last column, are the places actually employed in reducing the observations of the comet.

	RIGHT ASCENSION								DECLINATION							
	Mag'e.	Lalande.		Bessel	Piazzi.	Ast. Cat.	Loomis.	Mean.		Lalande.		Bessel.	Piazzi.	Ast Cat	Loomis	Mean
a	7	1h.48m.44s.17		44s.68	44s.17	44s.11	44s.34	44s.28	a'	+17 2 42".2		43".6	42 .8	42 .6	45 .8	43 .4
b	8	1 49	25 .73	25 .92		44 .24	25 .52	25 .72	b'	16 45	67 .0	61 .5		43".6	58 .3	62 .3
c	8	1 59	6 .53	6 .72	6 .34	Pond.	7 .33	6 .73	c'	17 16	32 .8	30 .1	30 .6	Pond.	31 .0	31 .1
d	7.8	2 9	1 .43				1 .83	1 .63	d'	17 13	14 .6				11 .5	13 .0
e	8	2 14	17 .00	17 .11			17 .08	17 .17	e'	16 52	33 .1	30 .9			30 .2	31 .5
f	6	2 22	9 .72	9 .67	9 .23	9 .32	9 .83	9 .55	f'	17 0	13 .6	12 .9	14 .0	17 .0		13 .5
g	8	2 31	24 .79	24 .95			24 .89	24 .88	g'	16 2	49 .3	42 .1			36 .3	42 .6
h	6.7	2 35	51 .61		51 .10	51 .17	51 .90	51 .44	h'	14 38	24 .7		28 .9	30 .2	21 .6	26 .3

The observations were corrected for the *difference* of refraction between the comet and star of comparison, by means of the formulæ

$$\text{Correction in A. R.} = 2\, r\, \Delta \sin \tfrac{1}{2} v \cos v \sec \delta$$

$$\text{Correction in Dec.} = r\, \Delta \cos^2 \tfrac{1}{2} v$$

Where $r =$ the difference of refraction for 1′ at the given altitude.

$\Delta =$ the difference of declination of the two objects.

$v =$ the angle of variation.

$\delta =$ the mean of the declinations of the star and comet.

The places in column fifth are corrected for refraction, parallax and aberration, and the last column exhibits the corrections of Encke's ephemeris according to the observations.

Date.	Differences observed	Sidereal Time	No of Obs.	Comet's Places	Correction of Ephemeris A. R.	Dec.
1842, March 28,	Comet—a = 1m.28s.37	8h.14m.18s.77	8	27 33 28 .5	+21 .7	
	Comet—b = 44 .71	8 17	7	33 12 .2		
	a'—Comet = 8′58″.0	8 14	18 .77	8	+16 53 49 .6	
	Comet—b' = 7 25 .3	8 17	7 .26	7	53 38 .9	—22 .3
March 30,	c—Comet = 1m.39s.00	8 20	5 .57	3	29 22 5 .7	+21 .0
	c'—Comet = 8′17″.3	8 20	5 .57	3	+17 8 18 .2	—12 .1
March 31,	Comet—e = 1m.38s.23	8 26	30 .20	11	30 16 37 .8	+26 .0
	e'—Comet = 3′22″.9	8 33	17 .74	8	+17 13 12 .9	—19 .1
April 1,	d—Comet = 4m.22s.58	8 25	17 .51	6	31 9 50 .2	— 2 .9
	d'—Comet = 26′46″.6	8 25	17 .51	6	+17 16 23 .2	—20 .1
April 4,	Comet—e = 38s.27	8 36	48 .57	8	33 44 31 .8	+11 .8
	Comet—e' = 19′28″.4	8 36	48 .57	8	+17 12 10 .4	—22 .6
April 5,	f—Comet = 4m. 5s.5	8 38	21 .26	7	34 31 26 .7	— 2 .1
	Comet—f' = 4′46″.3	8 45	23 .43	5	+17 5 4 .3	—13 .5
April 7,	Comet—f = 1m.30s.8	8 44	14 .39	5	35 55 12 .8	+ 0 .1
	f'—Comet = 21′ 3″.4	8 44	14 .39	5	+16 39 5 .8	—40 .5
April 9,	g—Comet = 3m.32s.37	8 56	17 .57	2	36 58 15 .4	—33 .4
	g'—Comet = 7′ 5″.7	8 56	17 .57	2	+15 55 32 .1	—50 .1
April 11,	h—Comet = 5m.38s.83	9 3	1 .00	3	37 33 42 .1	—70 .7

2. *The Great Comet of* 1843.

Owing to an extraordinary degree of cloudy weather, I made but few observations of this comet. They were all made in the mode described for Encke's comet, with the exception of that of March 11th, when the head having been discovered only a few minutes before its setting, it was brought as near as could be estimated by the eye, into the centre of the field, and the circles were read off. This was done four times, when the comet disappeared behind the trees. A star of the sixth magnitude, having nearly the same declination, was then observed repeatedly, in the same way. The following is a list of all the stars used in the series.

	Mag'e	Lalande		Bessel.	Ast. Cat.	Result employed		Lalande.	Bessel.	Ast. Cat.	Result employed
a	6	2*h*.14*m*.20*s*.84		21*s*.54		21*s*.19	*a*	—11°29′35″.0	39″.9		37 .4
b	4	3 8 13 67		13 .49	13*s*.21	13 .42	*b*	9 24 24 .6	25 .4	23″.8	25 .8
c	8	3 30 31 31		31 .67	13 .42	31 .67	*c*	8 0 10 .4	13 .5	25 .8	12 .5
d	7	3 30 49 87		50 .70	Pond.	50 .26	*d*	7 54 25 .1	30 .8	Pond.	28 .9
e	8.9	3 31		29 .06		29 .06	*e*	7 45	2 .4		2 .4
					Loomis.					Loomis.	
f	9	3 35			30 .24	30 .24	*f*	7 59		59 .4	59 .4
g	6	4 12 56 96				56 .96	*g*	6 37 26 .6			26 .6
h	8	4 13 49 57		19 .99		49 .85	*h*	6 26 59 .2	56 .0		57 .1
i	6.7	4 13 57 34				57 .34	*i*	6 39 48 .4			48 .4
k	8	4 23 17 56		18 .11		17 .93	*k*	5 18 23 .4	21 .2		21 .9
l	8	4 23 28 84		29 .45		29 .25	*l*	5 12 1 .2	1 .0		1 .1
m	8	4 24 37 06		37 .64		37 .45	*m'*	5 22 35 .8	40 .7		39 .1

The places given below, in columns fifth and sixth, are corrected for refraction, parallax and aberration, and the last two columns exhibit the corrections of the ephemeris, computed from Mr. Walker's fourth parabolic elements.

Date	Differences observed	Sidereal Time.	No. of Obs.	Comet's Places. A. R.	Comet's Places. Dec.	Correction of Ephemeris. A. R.	Correction of Ephemeris. Dec.
1843. March 11.	*a*—Comet = 30*m*.29*s*.	6*h*.53*m*.57*s*.	4	1*h*.43*m*.51*s*.			
	a—Comet = 5 50 .	"	4		—11°35 10 .		
March 21.	Comet—*b* = 3*m*. 9*s*.19	7 58 12 .27	7	3 11 27 .27		—5*s*.21	
	Comet—*b'* = 31 29″.6	"	7		8 52 31 .9		—15′.9
March 25.	Comet—*c* = 4*m*.49*s*.06	8 4 21 .53	5	3 35 23 .67		—1 .92	
	Comet—*d* = 4 30 .25	"	6	" 23 .27			
	Comet—*e* = 52 .38	"	5	" 23 .95			
	f—Comet = 9 .61	"	4	" 22 .92			
	Comet—*c'* = 11 59″.9	"	5		7 47 58 .7		—21 .9
	e'—Comet = 3 13 .3	"	4		" 65 .1		
	Comet—*f'* = 12 19 .8	"	3		" 25 .6		
April 1.	*g*—Comet = 4*m*.59*s*.54	8 42 33 .18	6	4 8 1 .21		+1 .86	
	h—Comet = 5 51 .92	"	6	" 1 .06			
	i—Comet = 6 0 .25	"	6	" 1 .00			
	Comet—*g'* = 26 26′.4	"	6		6 10 38 .4		—33 .0
	Comet—*i'* = 28 39 .9	"	6		" 45 .7		
April 5.	*k*—Comet = 0*m*.17*s*.36	9 21 52 .57	5	4 23 2 .41		+6 .93	
	l—Comet = 28 .66	"	5	" 2 .14			
	m—Comet = 1 38 .88	"	4	" 0 .62			
	k—Comet = 5 35 .8	"	2		5 23 50 .0		+ 8 .3
	l—Comet = 11 49 .8	"	3		" 45 .3		
	m—Comet = 1 10 .8	"	2		" 40 .9		
April 6.	Comet—*k* = 3*m*. 5*s*.64	9 8 15 .31	5	4 26 25 .77		+9 .46	
	Comet—*l* = 2 54 .73	"	5	" 26 .01			
	Comet—*m* = 1 45 .55	"	6	" 25 .31			
	l—Comet = 1′ 8 .6	"	4		5 12 60 .6		+34 .2
	Comet—*m'* = 9 11 .1	"	4		" 46 .9		

I have been intending to compute the most probable orbit of this comet from a comparison of all the observations. During the last half of March, the comet was followed at nearly all the European observatories; but before the middle of the month, very few accurate observations were made. It was observed at Trevandrum from the 6th of March, and at the Cape of Good Hope from the 3d. These last observations (if they possess any thing of the accuracy which may be anticipated from the character of the observer,) are indispensable to the computation of the final orbit, and I have been waiting hitherto for their publication. As soon as I receive them, I hope to find leisure to investigate the orbit which satisfies, in the best possible manner, all the published observations.

3. *The Mauvais Comet.*

This comet was observed from July 30, 1843, to October 1, twenty-five times. The observations, for the most part, were made in the usual way, with the equatorial, but in a few instances, it was observed in the transit instrument. These observations, however, are considered to be inferior to the former, for the comet would bear no illumination. The following are the places of the stars employed in this series of observations.

	RIGHT ASCENSIONS.							DECLINATIONS						
	Mag'e.	Lalande.	Bessel.	Piazzi.	Rumker	Loomis.	Mean employed.		Lalande.	Bessel	Piazzi	Rumker	[illegible]	Me[illegible]
a	7.8	23*h*. 0*m*.31*s*.11				31*s*.26	31*s*.20	*a'*	—26 40 9 .8				15 .2	9
b	6	1 19 .34				19 .55	19 .44	*b'*	28 55 50 .2				49 .4	50
c	8	7 0 .31				0 .09	0 .20	*c'*	25 41 55 .7					55
d	9	7				21 .25	21 .25	*d'*	28 1				28 .0	28
e	7	8 12 .54				11 .97	12 .35	*e'*	24 4 14 .6				13 .5	14
f	7	8 9 .61				9 .04	9 .61	*f'*	27 55 40 .9				35 .9	40
g	9	10 6 .30					6 .30	*g'*	25 51 3 .8					3
h	8	14 34 .39				34 .74	34 .51	*h'*	21 17 51 .3				61 .4	54
			Argelander.			Ast. Cat.				Argelander.			Ast. Cat	
i	7	24 8 .51	8*s*.46	8 .61	8 .07	8 .15	8 .43	*i'*	12 24 6 .7	7 .4	4 .5	8 .6	4 .9	6
k	6.7	24 21 .32	22 .22		21 .83	21 .49	21 .82	*k'*	11 51 22 .3	26 .9		25 .0	27 .3	25
l	8	25 9 .06	10 .07			9 .42	9 .52	*l'*	13 27 59 .5	63 .9			60 .1	62
m	8	27	24 .69			25 .28	24 .69	*m'*	11 24	52 .7			55 .6	52
n	7.8	27 57 .95	58 .57			58 .18	58 .32	*n'*	9 37 25 .7	31 .2			30 .0	29
o	8	29 40 .28	40 .09				40 .15	*o'*	10 49 58 .7	67 .9			73 .0	64
p	8	31 49 .87	50 .00		49 .93	49 .97	49 .93	*p'*	— 6 21 25 .0	27 .5		29 .1		27
q	4.5*	31 55 .25	56 .19	56 .10		56 .19	56 .19	*q'*	+ 1 46 79 .6	65 .7	51 .7		55 .1	55
						Pond.							Pond.	
r	6	38 26 .29	26 .41	25 .53	25 .89	26 .28	26 .28	*r'*	+ 2 37 27 .2	22 .1	27 .7	20 .4	23 .7	23
s	8	39 38 .60				38 .68	38 .60	*s'*	— 5 19 31 .2				38 .6	31
t	9	40	45 .76				45 .76	*t'*	— 5 18	1 .0				1
u	8	41 7 .96	8 .41		7 .87	7 .33	8 .10	*u'*	+ 5 30 59 .2	59 .0		56 .9		59
v	7	43 43 .17	42 .85			42 .05	42 .96	*v'*	+ 3 49 18 .3	49 .0			51 .2	48
w	7	43 55 .66	55 .85			56 .15	55 .79	*w'*	+ 3 52 14 .4	42 .4			44 .6	43

The comet's places given below are corrected like the former observations.

* This star (ε Piscium,) according to Piazzi, has a proper motion of + 0 .30 in A. R., and — 0 .55 in De-

Date.	Differences observed.	Sidereal Time.	No. of Obs.	Comet's Places. A. R.	Dec.
1813, July 30,	Transit circle $\left\{\begin{array}{l}23^h.38^m.57^s.21\\ +5^\circ\ 18'\ 55''.0\end{array}\right.$	$23^h.41^m.11^s.96$ "	1 1	$23^h.38^m.57^s.17$	$+5^\circ 18' 44''.1$
	u—Comet = $2^m.\ 9^s.25$	0 15 16 .96	2	23 38 58 .86	
	u'—Comet = 12′ 59″.0	"	2		5 17 48 .9
July 31,	Comet—q = $6^m.58^s.33$	18 31 44 .98	7	23 38 54 .10	
	Comet—q' = 1′ 1″.0	18 46 8 .32	4		4 47 45 .7
August 1,	v—Comet = $4^m.56^s.92$	18 41 18 .61	8	23 38 45 .34	
	w—Comet = 5 9 .92	"	8	23 38 45 .12	
	Comet—w' = 17′ 24″.9	"	8		4 9 59 .3
	Comet—v' = 20 12 .6	"	8		4 9 52 .9
August 2,	v—Comet = $5^m.\ 7^s.83$	18 38 20 .68	8	23 38 35 .14	
	w—Comet = 5 20 .58	"	8	23 38 35 .29	
	v'—Comet = 18′ 37″.6	18 42 8 .15	7		3 30 57 .9
	w'—Comet = 21 33 .2	"	7		3 30 56 .2
August 3,	r—Comet = $0^m.\ 3^s.99$	19 1 45 .71	20	23 38 21 .67	
	Comet—r' = 13′ 38″.3	19 21 46 .09	10		2 50 52 .1
August 5,	Transit circle $\left\{\begin{array}{l}23^h.37^m.51^s.69\\ +1^\circ\ 24'\ 20''.8\end{array}\right.$	23 37 51 .47 "	1 1	23 37 51 .58	1 24 9 .7
August 6,	Transit circle $\left\{\begin{array}{l}23^h.37^m.33^s.93\\ +0^\circ\ 44'\ 16''.8\end{array}\right.$	23 37 33 .76 "	1 1	23 37 33 .81	$+0\ 41\ 5\ .6$
August 15,	s—Comet = $5^m.55^s.1$	19 6 51 .92	5	23 33 42 .97	
	t—Comet = 7 1 .5	19 11 35 .90	4	23 33 43 .74	
	s'—Comet = 0′ 21″.1	19 16 28 .73	3		$-5\ 20\ 3\ .9$
	t'—Comet = 1 53 .6	"	3		5 20 6 .4
August 16,	Comet—p = $1^m.19^s.51$	19 38 8 .38	4	23 33 8 .66	
	Comet—p' = 22 4 .2	"	4		6 2 32 .9
August 21,	Comet—n = $2^m.\ 0^s.3$	0 27 7 .39	5	23 29 58 .45	
	Comet—n' = 1′ 27″.6	"	5		9 36 12 .6
August 23,	o—Comet = $56^s.88$	20 49 11 .40	10	23 28 42 .75	
	o'—Comet = 17″.2	"	10		10 51 3 .0
August 24,	Comet—m = $38^s.05$	20 20 35 .38	5	23 28 2 .22	
	m'—Comet = 4′ 49″.8	"	5		11 29 53 .8
August 25,	Comet—k = $2^m.51^s.94$	22 36 23 .68	4	23 27 13 .41	
	k'—Comet = 22′ 52″.8	22 30 53 .72	5		12 14 30 .1
August 26,	Comet—i = $2^m.25^s.67$	21 6 37 .52	6	23 26 33 .72	
	i'—Comet = 26′ 42″.6	"	6		12 51 1 .3
August 27,	Comet—l = $10^s.21$	21 37 8 .54	12	23 25 49 .26	
	l'—Comet = 2′ 18″.4	"	12		13 30 31 .2
September 16,	Comet—e = $2^m.36^s.52$	21 3 13 .80	10	23 10 48 .53	
	e'—Comet = 14′ 42″.5	"	10		24 19 6 .6
September 17,	h—Comet = $4^m.25^s.8$	20 51 59. 99	5	23 10 8 .54	
	h'—Comet = 24′ 53″.4	"	5		24 42 59 .2
September 19,	Comet—c = $1^m.18^s.53$	21 40 21 .60	5	23 8 48 .22	
	g—Comet = 1 16 .34	21 28 17 .91	8	23 8 49 .36	
	Comet—c' = 10′ 14″.1	21 40 21 .60	5		25 31 16 .3
	Comet—g' = 19 52 .2	21 28 17 .91	8		25 31 14 .8
September 20,	g—Comet = $1^m.52^s.74$	20 45 21 .95	10	23 8 13 .10	
	g'—Comet = 2′ 7″.7	"	10		25 53 18 .3
September 21,	g—Comet = $2^m.30^s.2$	21 18 39 .33	5	23 7 35 .90	
	g'—Comet = 24′ 37″.4	"	5		26 15 51 .5
September 22,	Comet—a = $6^m.30^s.2$	21 38 37 .00	5	23 7 0. 96	
	Comet—a' = 2′ 28″.1	"	5		26 37 46 .9
September 23,	Comet—a = $5^m.52^s.83$	21 46 10 .48	6	23 6 23 .75	
	a'—Comet = 17′ 31″.8	"	6		26 57 49 .8
September 27,	d—Comet = $3^m.\ 4^s.67$	22 0 46 .82	6	23 4 16 .29	
	f—Comet = 3 53 .07	"	6	23 4 16 .29	
	d'—Comet = 12′ 18″.9	22 4 7 .70	5		28 13 53 .4
	f'—Comet = 17 55 .2	"	5		28 13 43 .6
September 29,	Comet—b = $2^m.\ 3^s.05$	22 47 25 .26	10	23 3 22 .21	
	Comet—b' = 7′ 31″.3	22 48 12 .48	9		28 48 21 .8
October 1,	Comet—b = $1^m.\ 8^s.4$	1 8 21 .58	7	23 2 27 .25	
	b'—Comet = 25′ 1″.8	"	7		29 21 3 .1

4. *The Faye Comet.*

I was absent from Hudson at the time the news of the discovery of this comet first reached this country, and had no opportunity to observe it until January 23, 1844. Then followed a succession of cloudy days, which, with the moon, prevented observations until February 10, when it was observed, although with some difficulty. The following evening I saw it again, but found it so extremely faint that I concluded to follow it no farther. The following are the stars of comparison employed.

	RIGHT ASCENSION.							DECLINATION						
	Mag'e.	Lalande.	Bessel.	Rumker.	Pond.	Loomis.	Result.		Lalande.	Bessel.	Rumker	Pond	Loomis	Result
a	8.9	5*h*.12*m*.50*s*.58	50*s*.44	50*s*.12			50*s*.34	*a'*	+4° 18′ 57″.62	49″.95	52″.59			52″.54
b	2	5 16			48*s*.12		18 .12	*b'*	6 12			8″.99		8 .99
c	9	5 26				25*s*.±1*s*.	25 .00	*c'*	6 26				18″ ±20″	18

The following observations are arranged in the usual manner.

Date.	Differences observed.		Sidereal Time.		No of Obs.	Comet's Places. A. R.		Dec
1844, Jan. 23,	*a*—Comet =	18*s*.38	3*h*.48*m*.29*s*.32		7	5*h*.12*m*.32*s*.00		
	Comet—*a'* =	16′ 9″.2	"		7			+1° 35′ 6″.8
February 10,	Comet—*b* =	8*m*.51*s*.00	5 52 32 .72		3	5 25 39 .60		
	c—Comet =	47 .47	"		3			
	Comet—*b'* =	22′ 6″.1	"		3			6 34 23 .0
	Comet—*c'* =	7 46 .2	"		3			
February 11,	Comet—*c* =	8*s*.	5 56		1	5 26 33 .48		

The present paper concludes my astronomical labours at Hudson, having resigned the observatory into the hands of Professor James Nooney, from whose zeal and ability much may be expected in the cause of science.

ARTICLE II.

Supplementary Note on the Construction and different Forms of the Magic Cyclovolute.
By E. Nulty. Read December 6, 1844.

The arrangement of numbers, denominated a *Magic Cyclovolute*, and published in the fifth volume of the Society's Transactions, 1835, has for its basis a *perfect magic square*, formed of the sixty-four integral numbers, 1, 2, 3 . . . 64. This peculiar square essentially differs, in its construction, from the basis of the magic circle, which must be viewed as *imperfect*, so far as respects an inequality which subsists between the sums of the numbers along its horizontal and vertical rows, and those constituting its principal diagonals. The perfect form which we here propose to construct may be regarded as compound, and as generated from two others: one consisting of binary combinations taken from the series of eight numbers, 1, 2, 3 . . . 8; the other, of multiples by *eight* of the different terms of the corresponding series, 0, 1, 2 . . . 7, and which, being joined by addition to the preceding, will evidently give the several terms of the first series, 1, 2, 3 . . . 64. In order to exhibit these component squares in reference to the particular arrangement published, let us take the two binary combinations (1, 8) and (2, 7), which being placed in vertical and horizontal rows, will form the two following elementary magic squares:

1 2	8 7
8 7	1 2

1 2	8 7
8 7	1 2

. . . . (*a*)

1 8	1 8
7 2	7 2

8 1	8 1
2 7	2 7

. . . . (*a*)

In like manner from the two binary combinations (3, 6) and (4, 5), let us form the analogous perfect squares,

3 4	6 5
6 5	3 4

3 4	6 5
6 5	3 4

. . . . (*b*)

3 6	3 6
5 4	5 4

6 3	6 3
4 5	4 5

. . . . (*b*)

in which, and the preceding, the upper row of the first is made the descending diagonal of the second; and the upper row of the second is the leading vertical row of the first.

If we repeat these partial squares, the first and third, (a) and (b), vertically; and the second and fourth, (a') and (b'), horizontally, we shall obtain by their junction the following complete magic squares, (A) and (B), which as respects their diagonal and leading rows, are constituted in a manner similar to their components, (a), (a') and (b), (b'):

(A)

1 2	8 7	3 4	6 5
8 7	1 2	6 5	3 4
1 2	8 7	3 4	6 5
8 7	1 2	6 5	3 4
1 2	8 7	3 4	6 5
8 7	1 2	6 5	3 4
1 2	8 7	3 4	6 5
8 7	1 2	6 5	3 4

(B)

1 8	1 8	1 8	1 8
7 2	7 2	7 2	7 2
8 1	8 1	8 1	8 1
2 7	2 7	2 7	2 7
3 6	3 6	3 6	3 6
5 4	5 4	5 4	5 4
6 3	6 3	6 3	6 3
4 5	4 5	4 5	4 5

Of these fundamental squares, which we prefer in their present forms, either may be considered as a *primitive*, the other its *derivative*. To suit our present purpose we shall take (A) as primitive, and we shall mentally diminish its several numbers by unity in accordance with the series 0, 1, 2...7. By multiplying each of the remainders thus obtained by eight, and adding their products in successive order to the corresponding numbers, similarly posited in the derivative (B), we shall readily construct the perfect magic square (AB), of which all the rows, whether vertical, horizontal, or diagonal, amount to 260; and which is obviously composed of four perfect magic squares, having their diagonals and other rows each equal to 130, the common amount of every four adjacent numbers in the entire square.

(AB)

1 16	57 56	17 32	41 40
63 50	7 10	47 34	23 26
8 9	64 49	24 25	48 33
58 55	2 15	42 39	18 31
3 14	59 54	19 30	43 38
61 52	5 12	45 36	21 28
6 11	62 51	22 27	46 35
60 53	4 13	44 37	20 29

The arrangement here given is remarkable. It will remain perfectly magic when any number of its vertical rows are removed in order, and placed in succession after the last; and also when any number of its upper or lower horizontal rows undergo a similar displacement. Such permanency in the magic structure of (AB) follows from the peculiar mode in which the binary combinations taken from the series 1, 2, 3...8, are disposed in the fundamental forms (A) and (B); and hence we are immediately led to the constant result of the several principal and secondary rings of the magic cyclovolute.

As to the general result common to all the volutes and the particular property, inserted in the Bulletin of the society, (No. 13, 1840), in reference to the sixteen semi-volutes, reckoned from the extremities of the principal diameters AA', BB', and the corresponding points a, a', and b, b', they are a consequence of (AB) rendered perfectly magic, as well as the four squares which compose it. With these semi-volutes, we may also notice the sixteen semi-radii in the drawing. The four numbers in each of them with half the auxiliary 12 amount to 180; and a like result will always hold good for every four numbers taken in adjacent pairs from the centre, or, from the remote extremities of any radius. These supplemental properties render peculiar the *form* of the drawing as now considered, and give it every possible generality.

The square (AB) will directly bring to view the arrangement adopted in the drawing. We have merely to increase each of its numbers by 11, in order to adapt it to the amount 360, employed by the author of the magic circle, instead of 260 above-mentioned; and to place the same horizontal rows of the corresponding magic square in succession round the principal rings of the cyclovolute, above and below the principal diameter AA.

Let us now determine the number of magic cyclovolutes that may be constructed by arranging differently the terms of the series 1, 2, 3 ... 64. With this view, let us return to the first squares (a), (a'), and let them be combined with similar squares formed from the reverse binary combinations (5, 4) and (6, 3) and constituting (c) and (c') here given:

5 6 ‖ 4 3	
4 3 ‖ 5 6	
5 6 ‖ 4 3	
4 3 ‖ 5 6	

. . . . (c)

5 1	5 1
3 6	3 6
4 5	1 5
6 3	6 3

. . . . (c')

We shall then obtain, as before, the two new fundamental squares (A) and (B):

1 2	8 7	5 6	4 3
8 7	1 2	4 3	5 6
1 2	8 7	5 6	4 3
8 7	1 2	4 3	5 6
1 2	8 7	5 6	4 3
8 7	1 2	4 3	5 6
1 2	8 7	5 6	4 3
8 7	1 2	4 3	5 6

. . . . (A')

1 8	1 8	1 8	1 8
7 2	7 2	7 2	7 2
8 1	8 1	8 1	8 1
2 7	2 7	2 7	2 7
5 4	5 4	5 4	5 1
3 6	3 6	3 6	3 6
4 5	4 5	4 5	4 5
6 3	6 3	6 3	6 3

. . . . (B')

which are precisely similar to (A) and (B); and may be employed for like purposes. If we use (A') as a primitive in the manner of (A) already treated, we shall find from it and the derivative (B') the compound square $(A'B')$, in which and any similar arrangement, attention must be paid to the order of the letters A', B', as indicative of the particular mode of combination. Besides the two compound squares (AB), $(A'B')$, thus obtained, we may in a similar manner obtain the squares (BA), $(B'A')$, and also the four additional squares (AB') $(A'B)$, and (BA') $(B'A)$; so that the elementary forms (a) and (a') considered as invariable, will thus lead to *eight* compound magic squares, having all the same properties. It is also evident that the binary combinations (1, 8), (3, 6), and (1, 8), (5, 4), will also furnish squares analogous to (a), (a'), by which and the remaining combinations (2, 7), (4, 5), and (2, 7), (6, 3), we shall be enabled to form *sixteen* new compound magic squares, which, with the preceding eight, amount to twenty-four different arrangements, as given at the end of this note.

We may immediately derive other forms from these, simply by interchanging the first and second vertical rows, the third and fourth, &c. By virtue of the forms (A_1) (A_1'), the resulting squares will be similar to (AB); and, in this way, the number of arrangements becomes forty-eight. These are the only changes that can be made in the vertical rows, so as to give essentially different magic cyclovolutes. To obtain other arrangements we must change the order of the horizontal rows, which, commencing with the upper, we shall briefly denote by the numbers 1, 2, 3, 4 ‖ 5, 6, 7, 8. If we interchange every two of these, the resulting form will be 2, 1, 4, 3 ‖ 6, 5, 8, 7; and taking also the second direct form, 1, 8, 3, 6 ‖ 5, 1, 7, 2, which is equally applicable, there will, in like manner,

result 8, 1, 6, 3 ‖ 4, 5, 2, 7. These may have each four of their rows inverted, relatively to their partial squares, in the order 4, 3, 2, 1 ‖ 8, 7, 6, 5, &c. Every magic square (C) of the forty-eight above considered will thus give seven others, (C_1), (C_2), . . . (C_7); and accordingly, the total number of different arrangements similar to (C) will become $48 \cdot 8 = 384$. We may obviously invert each of these arrangements in the circular distribution of their rows, round the principal rings of the drawing, and we shall thus have it in our power to construct 768 corresponding magic cyclovolutes.

In the formation of all the arrangements hitherto determined, we have kept in view the various properties ascribed to the magic cyclovolute, based on the square (AB). By merely excluding the consideration of that particular property, connected with the numbers taken in pairs along the radii of the drawing, as already mentioned, an additional group of magic cyclovolutes may be constructed, which with the 768 preceding, will amount to 6044; and other groups would result in case the semi-volutes, or the semi-radii, or both, were left unnoticed as minor properties. It would be somewhat tedious, and of no particular interest, to ascertain the precise number of forms corresponding to each of these limited hypotheses. We shall therefore omit any results of this kind, and proceed directly to investigate the total number of unclassified magic cyclovolutes, including the 6044 above determined, and all the general properties originally enumerated.

Let us then return to the form 1, 2, 3, 4 ‖ 5, 6, 7, 8, adopted for any magic square (C), and let us observe that no two *odd*, or two *even* numbers, indicative of the horizontal rows, can be disposed and arranged successively in any derivative form, considered as the basis of a magic cyclovolute. The reason of this will appear from the square (AB), to which all additional forms must preserve a like structure. Attending to this essential condition, the number of combinations of the *four* odd rows, 1, 3, 5, 7, or of the *four* even rows, 2, 4, 6, 8, taken in pairs, is $\frac{1}{2}(4 \cdot 3) = 6$; and these combined in *fours*, of which two are *odd* and two *even*, will give $6 \cdot 6 = 36$ forms, and consequently eighteen different arrangements analogous to 1, 2, 3, 4 ‖ 5, 6, 7, 8. But any of these forms so constructed, as for instance, the preceding, admits of *four* changes with respect to the rows 1, 2, 3, 4, and also *four* for the rows 5, 6, 7, 8. These rows may therefore be combined $4 \cdot 4 = 16$ ways; and taking the inverse form 4, 3, 2, 1 ‖ 8, 7, 6, 5, as equally admissible, we shall have thirty-two arrangements, instead of the single primitive form 1, 2, 3, 4 ‖ 5, 6, 7, 8; and the eighteen different arrangements previously determined will generate the number $18 \cdot 32 = 576$. By viewing these combinations in a less specific manner, the number just found will result as the square of $(4 \cdot 3 \cdot 2 \cdot 1)$, the permutations of either the odd or even rows. We shall thus increase the forty-eight magic squares first considered to $48 \cdot 576 = 3 \cdot 96^2$ or 27648, which may be all obtained from the series of sixty-four numbers, 1, 2, 3 . . . 64, and converted into magic cyclovolutes. The total number of these remarkable arrangements, with all the leading properties in my paper in the Transactions of the Society, therefore, amount to $6 \cdot 96^2 = 55296$.

In connexion with our subject, we shall here bring to notice a *new* imperfect magic square, analogous to that adopted by Dr. Franklin in the construction of his magic circle; but which so far generalizes it, as to include the particular property of the numbers taken in pairs along the several radii, as already mentioned in case of the cyclovolute. It is

singular that this extension should have hitherto escaped notice, and that the magic circle in its present form should yet admit of improvement. To establish this point let us form the two elementary squares (d) and (d') thus:

1	2	7	8
8	7	2	1
2	1	8	7
7	8	1	2

. . . . (d)

1	8	1	8
7	2	7	2
2	7	2	7
8	1	8	1

. . . (d')

and also similar squares, (e), (e') and (f), (f') by means of the binary combinations (3, 6), (4, 5) and (5, 4), (6, 3). The repetition of these will give *four* fundamental squares, (D), (E) and (D), (E'), the second and fourth of which are imperfectly magic; and from these by combination, we shall obtain the *eight* imperfect magic squares (DE), $(D\,E)$, &c., the first of which is here subjoined. The manner in which these *eight* are increased to *forty-eight*, we have already explained, and taking the *three* combinations 1, 2, 3, 4 ‖ 5, 6, 7, 8, and 1, 4, 7, 6 ‖ 5, 8 3, 2, and 1, 2, 7, 8 ‖ 5, 6, 3, 4, we shall immediately find by their changes the number $48 \cdot 32 = 1536$ magic circles with our additional properties; $48 \cdot 160 = 7680$ of Dr. Franklin's limited form; and the total number without distinction of properties will result as before $6 \cdot 96^2 = 55296$.

(DE)

1	16	19	61	17	32	33	48
63	50	15	2	47	34	31	18
10	7	58	55	26	23	42	39
56	57	8	9	40	41	24	25
3	14	51	62	19	30	35	46
61	52	13	4	45	36	29	20
12	5	60	53	28	21	44	37
54	59	6	11	38	43	22	27

The principles by which we have been guided to the various results in this paper, we judge of considerable moment in regard to the magical combination of numbers. They may be readily applied to the extensive series of 256 numbers 1, 2, 3 . . . 256, first considered in a magic form by Dr. Franklin, and left combined by him in an imperfect magic square, similar in properties to the base of his magic circle. This he no doubt intended as a generalized base of an enlarged magic circle, but owing to an oversight in two or three of the numbers, it would not be applicable. In Dr. Hutton's Mathematical Dictionary, which I have lately consulted, this imperfection is said to have been noticed by Mr. Dalby, "first Professor at the Royal Military College;" and to this ingenious mathematician is ascribed the formation of a remarkable magic square of *sixteen* perfect magic squares, including the above series; and which is given in the work just cited. Without the slightest intimation of Mr. Dalby's square, or that of any other person, I had been led to several analogous arrangements. My method is that employed in case of the perfect magic square (AB). I formed from the binary combinations (1, 16), (2, 15), (3, 14), (4, 13) and (5, 12), (6, 11), (7, 10), (8, 9), the elementary squares

1	2	16	15	3	4	14	13
16	15	1	2	14	13	3	4
1	2	16	15	3	4	14	13
16	15	1	2	14	13	3	4
1	2	16	15	3	4	14	13
16	15	1	2	14	13	3	4
1	2	16	15	3	4	14	13
16	15	1	2	14	13	3	4

. . . . (g)

5	6	12	11	7	8	10	9
12	11	5	6	10	9	7	8
5	6	12	11	7	8	10	9
12	11	5	6	10	9	7	8
5	6	12	11	7	8	10	9
12	11	5	6	10	9	7	8
5	6	12	11	7	8	10	9
12	11	5	6	10	9	7	8

. . . . g

the descending diagonal rows of which were made the leading vertical rows of two similar squares, (h), (h'); and from the reverse combinations (9, 8), (10, 7), (11, 6), (12, 5), I constructed two additional squares (i), (i'). It is obvious that I had it in my power to form other analogous squares, by taking in a different order the combinations here given. From the squares thus made, I obtained the fundamental squares (G), (H), (G'), (H'); and from these, as before, the compound perfect arrangements (GH), (HG), &c. To serve as a comparison with Mr. Dalby's, and to notice its remarkable properties in my own way, I shall present the second combination, (HG).

New perfect magic square, including sixteen perfect magic squares, formed of the series of 256 *numbers*, 1, 2, 3 . . . . 256.

1 212	16 255	3 244	14 253	5 246	12 251	7 228	10 229
240 31	225 18	238 29	227 20	236 27	229 22	234 25	231 24
241 2	256 15	243 4	254 13	245 6	252 11	247 8	250 9
32 239	17 226	30 237	19 228	28 235	21 230	26 233	23 232
33 210	48 223	35 212	46 221	37 214	41 219	39 216	42 217
208 63	193 50	206 61	195 52	204 59	197 54	202 57	199 56
209 34	224 47	211 36	222 45	213 38	220 43	215 40	218 41
64 207	49 194	62 205	51 196	60 203	53 198	58 211	55 200
65 178	80 191	67 180	78 189	69 182	76 187	71 184	74 185
176 95	161 82	174 93	163 84	172 91	165 86	170 89	167 88
177 66	192 79	179 68	90 77	181 70	188 75	183 72	186 73
96 175	81 162	94 173	83 164	92 171	85 166	90 169	87 168
97 146	112 159	99 148	110 157	101 150	108 155	103 152	106 153
144 137	129 114	142 125	131 116	140 123	133 118	138 121	135 120
145 98	160 111	147 100	158 109	149 105	156 107	151 104	154 105
128 143	113 130	126 141	115 132	124 139	117 134	122 137	119 136

. . (*HG*)

Besides the properties expressed in the title of this new perfect magic square; every four numbers round the centre of any component square, or at the two opposite sides, or at the four angles, always give the same amount 514, which is also the result of each corresponding row, whether horizontal, vertical, or diagonal. Every four adjacent numbers round any point, wherever taken, amount to 514. The properties of the whole square remain when its component squares are removed in vertical or horizontal rows from one side to the other; and it will continue perfectly magical, when any number of its single vertical, or horizontal rows are subjected to a like displacement, as already explained in case of the smaller square (AB), to which it bears constant analogy, but with increased variety in respect to the number and possible location of its magic components.

It will be observed that Mr. Dalby has left no theoretical construction of his magic square; and that the mode by which Dr. Hutton obtains it in his Dictionary is indirect and limited.

His method gives but one form: mine will lead without difficulty to every form of which the arrangement is susceptible; and should it be made the basis of an increased magic cyclovolute, we might determine its varieties. The remark here made applies to the square of Dr. Franklin. A number of similar and generalized forms may be obtained by imitating the elementary squares, (d), (d'), &c.

This supplementary note has extension adequate to every purpose intended. It embraces the essential principles on which depend the construction of the magic cyclovolute, and that of the magic circle; and, in the way of generalization, exhibits no unfavourable instance of contrast. Although the author has long regarded it as a necessary appendage to his paper; and as possessing some novel interest on a curious subject; he has perhaps been rather too indifferent as to the advantages usually attributed to an early publication.

Fundamental arrangements for varieties of the Magic Cyclovolute.

FIRST CLASS.

A

1 2	8 7	3 4	6 5
8 7	1 2	6 5	3 4
1 2	8 7	3 4	6 5
8 7	1 2	6 5	3 4
1 2	8 7	3 4	6 5
8 7	1 2	6 5	3 4
1 2	8 7	3 4	6 5
8 7	1 2	6 5	3 4

B

1 8	1 8	1 8	1 8
7 2	7 2	7 2	7 2
8 1	8 1	8 1	8 1
2 7	2 7	2 7	2 7
3 6	3 6	3 6	3 6
5 4	5 4	5 4	5 4
6 3	6 3	6 3	6 3
4 5	4 5	4 5	4 5

A'

1 2	8 7	5 6	4 3
8 7	1 2	4 3	5 6
1 2	8 7	5 6	4 3
8 7	1 2	4 3	5 6
1 2	8 7	5 6	4 3
8 7	1 2	4 3	5 6
1 2	8 7	5 6	4 3
8 7	1 2	4 3	5 6

B'

1 8	1 8	1 8	1 8
7 2	7 2	7 2	7 2
8 1	8 1	8 1	8 1
2 7	2 7	2 7	2 7
5 4	5 4	5 4	5 4
3 6	3 6	3 6	3 6
4 5	4 5	4 5	4 5
6 3	6 3	6 3	6 3

(AB)

1 16	57 56	17 32	41 40
63 50	7 10	47 34	23 26
8 9	64 49	24 25	48 33
58 55	2 15	42 39	18 31
3 14	59 54	19 30	43 38
61 52	5 12	45 36	21 28
6 11	62 51	22 27	46 35
60 53	4 13	44 37	20 29

(BA)

1 58	8 63	3 60	6 61
56 15	49 10	54 13	51 12
57 2	64 7	59 4	62 5
16 55	9 50	14 53	11 52
17 42	24 47	19 44	22 45
40 31	33 26	38 29	35 28
41 18	18 23	43 20	46 21
32 39	25 34	30 37	27 36

$(A'B')$

1 16	57 56	33 48	25 24
63 50	7 10	31 18	39 42
8 9	64 49	40 41	32 17
58 55	2 15	26 23	34 47
5 12	61 52	37 44	29 20
59 51	3 14	27 22	35 46
4 13	60 53	36 45	28 21
62 51	6 11	30 19	38 43

$(B'A')$

1 58	8 63	5 62	4 59
56 15	49 10	52 11	53 14
57 2	64 7	61 6	60 3
16 55	9 50	12 51	13 54
33 26	40 31	37 30	36 27
24 47	17 42	20 43	21 46
25 34	32 39	29 38	28 35
48 23	41 18	44 19	45 22

(AB')

1 16	57 16	17 32	41 40
63 58	7 10	47 31	28 26
8 9	64 49	24 25	48 33
58 55	2 15	42 39	18 31
5 12	61 52	21 28	45 36
59 54	3 14	43 38	19 30
4 13	60 53	20 29	44 37
62 51	6 11	46 35	22 27

$(B'A)$

1 58	8 63	3 60	6 61
56 15	49 10	54 13	51 12
57 2	64 7	59 4	62 5
16 55	9 50	14 53	11 52
33 26	40 31	35 28	38 29
24 47	17 42	22 45	19 44
25 34	32 39	27 36	30 37
48 23	41 18	46 21	43 20

$(A'B)$

1 16	57 56	33 48	25 24
63 50	7 10	31 18	39 42
8 9	64 49	40 41	32 17
58 55	2 15	26 23	34 47
3 14	59 54	35 46	27 22
61 52	5 12	29 20	37 44
6 11	62 51	38 43	30 19
60 53	4 13	28 21	36 45

(BA')

1 58	8 63	5 62	4 59
56 15	49 10	52 11	53 14
57 2	64 7	61 6	60 3
16 55	9 50	12 51	13 54
17 42	24 47	21 46	20 43
40 31	33 26	36 27	37 30
41 18	48 23	45 22	44 19
32 39	25 34	28 35	29 38

SECOND CLASS.

A_2

1 3	8 6	2 4	7 5
8 6	1 3	7 5	2 4
1 3	8 6	2 4	7 5
8 6	1 3	7 5	2 4
1 3	8 6	2 4	7 5
8 6	1 3	7 5	2 4
1 3	8 6	2 4	7 5
8 6	1 3	7 5	2 4

B_2

1 8	1 8	1 8	1 8
6 3	6 3	6 3	6 3
8 1	8 1	8 1	8 1
3 6	3 6	3 6	3 6
2 7	2 7	2 7	2 7
5 4	5 4	5 4	5 4
7 2	7 2	7 2	7 2
4 5	4 5	4 5	4 5

A_2'

1 3	8 6	5 7	4 2
8 6	1 3	4 2	5 7
1 3	8 6	5 7	4 2
8 6	1 3	4 2	5 7
1 3	8 6	5 7	4 2
8 6	1 3	4 2	5 7
1 3	8 6	5 7	4 2
8 6	1 3	4 2	5 7

B_2'

1 8	1 8	1 8	1 8
6 3	6 3	6 3	6 3
8 1	8 1	8 1	8 1
3 6	3 6	3 6	3 6
5 4	5 4	5 4	5 4
2 7	2 7	2 7	2 7
4 5	4 5	4 5	4 5
7 2	7 2	7 2	7 2

(A_2B_2)

1 24	57 48	9 32	49 40
62 43	6 19	54 35	14 27
8 17	64 41	16 25	56 33
59 46	3 22	51 38	11 30
2 23	58 47	10 31	50 39
61 44	5 20	53 36	13 28
7 18	63 42	15 26	55 34
60 45	4 21	52 37	12 29

(B_2A_2)

1 59	8 62	2 60	7 61
48 22	41 19	47 21	42 20
57 3	64 6	58 4	63 5
24 46	17 43	23 45	18 44
9 51	16 54	10 52	15 53
40 30	33 27	39 29	34 28
49 11	56 14	50 12	55 13
32 38	25 35	31 37	26 36

$(A_2'B_2')$

1 24	57 48	33 56	25 16
62 43	6 19	30 11	38 51
8 17	64 41	40 49	32 9
59 46	3 22	27 14	35 54
5 20	61 44	37 52	29 12
58 47	2 23	26 15	34 55
4 21	60 45	36 53	28 13
63 42	7 18	31 10	39 50

$(B_2'A_2')$

1 59	8 62	5 63	4 58
48 22	41 19	44 18	45 23
57 3	64 6	61 7	60 2
24 46	17 43	20 42	21 47
33 27	40 30	37 31	36 26
16 54	9 51	12 50	13 55
25 35	32 38	29 39	28 34
56 14	49 11	52 10	53 15

(A_2B_2')

1 24	57 48	9 32	49 40
62 43	6 19	54 35	14 27
8 17	64 41	16 25	56 33
59 46	3 22	51 38	11 30
5 20	61 44	13 28	53 36
58 47	2 23	50 39	10 31
4 21	60 45	12 29	52 37
63 42	7 18	55 34	15 26

$(B_2'A_2)$

1 59	8 62	2 60	7 61
48 22	41 19	47 21	42 20
57 3	64 6	58 4	63 5
24 46	17 43	23 45	18 44
33 27	40 30	34 28	39 29
16 35	17 38	15 53	10 52
25 35	32 38	26 36	31 37
56 14	49 11	55 13	50 12

$(A_2'B_2)$

1 24	57 48	33 56	25 16
62 43	6 19	30 11	38 51
8 17	64 41	40 49	32 9
59 46	3 22	27 14	35 54
2 23	58 47	34 55	26 15
61 44	5 20	29 12	37 52
7 18	63 42	39 50	31 10
60 45	4 21	28 13	36 53

(B_2A_2')

1 59	8 62	5 63	4 58
48 22	41 19	44 18	45 23
57 3	64 6	61 7	60 2
24 46	17 43	20 42	21 47
9 51	16 54	13 55	12 50
40 30	33 27	36 26	37 31
49 11	56 14	53 15	52 10
32 38	25 35	28 34	29 39

THIRD CLASS.

A_3

1 5	8 4	2 6	7 3
8 4	1 5	7 3	2 6
1 5	8 1	2 6	7 3
8 4	1 5	7 3	2 6
1 5	8 4	2 6	7 3
8 4	1 5	7 3	2 6
1 5	8 4	2 6	7 3
8 1	1 5	7 3	2 6

B_3

1 8	1 8	1 8	1 8
4 5	4 5	4 5	4 5
8 1	8 1	8 1	8 1
5 4	5 4	5 4	5 4
2 7	2 7	2 7	2 7
3 6	3 6	3 6	3 6
7 2	7 2	7 2	7 2
6 3	6 3	6 3	6 3

A_3'

1 5	8 4	3 7	6 2
8 4	1 5	6 2	3 7
1 5	8 4	3 7	6 2
8 4	1 5	6 2	3 7
1 5	8 4	3 7	6 2
8 4	1 5	6 2	3 7
1 5	8 4	3 7	6 2
8 4	1 5	6 2	3 7

B_3'

1 8	1 8	1 8	1 8
4 5	4 5	4 5	4 5
8 1	8 1	8 1	8 1
5 4	5 4	5 4	5 4
3 6	3 6	3 6	3 6
2 7	2 7	2 7	2 7
6 3	6 3	6 3	6 3
7 2	7 2	7 2	7 2

(A_3B_3)

1 40	57 32	9 48	49 24				
60 29	4 37	52 21	12 45				
8 33	61 25	16 41	56 17				
61 28	5 36	53 20	13 44				
2 39	58 31	10 47	50 23				
59 30	3 38	51 22	11 46				
7 34	63 26	15 42	55 18				
62 27	6 35	54 19	14 43				

(B_3A_3)

1 61	8 60	2 62	7 59				
32 36	25 37	31 35	26 38				
57 5	64 4	58 6	63 3				
40 28	33 29	37 27	34 30				
9 53	16 52	10 54	15 51				
24 44	17 45	23 43	18 46				
49 13	56 12	50 14	55 11				
18 20	41 21	47 19	42 22				

$(A_3'B_3')$

1 40	57 32	17 56	41 16				
60 29	4 37	14 13	20 53				
8 33	61 25	24 49	48 9				
61 28	5 36	45 12	21 52				
3 38	59 30	19 54	43 14				
58 31	2 39	42 15	18 55				
6 35	62 27	22 51	46 11				
63 26	7 34	47 10	23 50				

$(B_3'A_3')$

1 61	8 60	3 63	6 58				
32 36	25 37	30 34	27 39				
57 5	64 4	59 7	62 2				
40 28	33 29	38 26	35 31				
17 45	24 44	19 47	22 42				
16 52	9 53	14 50	11 55				
41 21	48 20	43 23	16 18				
56 12	49 13	51 10	51 15				

(A_3B_3)

1 40	57 32	9 48	49 24				
60 29	4 37	52 21	12 45				
8 33	61 25	16 41	56 17				
61 28	5 36	53 20	13 44				
3 38	59 30	11 46	51 22				
58 31	2 39	50 23	10 47				
6 35	62 27	14 43	54 19				
63 26	7 34	55 18	15 42				

$(B_3'A_3)$

1 61	8 60	2 62	7 59				
32 36	25 37	31 35	26 38				
57 5	64 4	58 6	63 3				
40 28	33 29	37 27	34 30				
17 45	24 44	18 46	23 43				
16 52	9 53	15 51	10 54				
41 21	48 20	42 22	47 19				
56 12	49 13	55 11	50 14				

$(A_3'B_3)$

1 40	57 32	17 56	41 16				
60 29	4 37	44 13	20 53				
8 33	61 25	24 49	48 9				
61 28	5 36	45 12	21 52				
2 39	58 31	18 55	42 15				
59 30	3 38	43 14	19 54				
7 34	63 26	23 50	47 10				
62 27	6 35	46 11	22 51				

(B_3A_3')

1 61	8 60	3 63	6 58				
32 36	25 37	30 34	27 39				
57 5	64 4	59 7	62 2				
40 28	33 29	38 26	35 31				
9 53	16 52	11 55	14 50				
24 44	17 45	21 42	19 47				
49 13	56 12	51 15	54 10				
48 20	41 21	46 18	43 23				

ARTICLE III.

Materials towards a History of the Coleoptera Longicornia of the United States.
By S. S. Haldeman. Read January 17, 1845.

The distinguishing characters of the insects to be brought under consideration in this paper are, the length of the antennæ, the emargination of the eyes, and the possession of four articulations (the third of which is bilobed,) to all the tarsi. They feed upon vegetable matter both in the larva and perfect state, and are consequently most usually found in woods.

This tribe contains, with the exception of the Lamellicornia, or beetles, the largest individuals among the Coleoptera; and when we take their size and beauty into consideration, it appears singular that they should have escaped the special notice of entomologists for so long a period; for although Fabricius, Olivier, and others, had made us acquainted with a large number of species, a detailed account of the genera was wanting, until M. Serville published his "Nouvelle Classification," in the year 1832. Since then, various authors have added to the genera, so that by this time there must be about four hundred, and who can doubt that, in judicious hands, farther subdivisions could be made with advantage. The genera I have ventured to present as new, are such as I cannot satisfactorily refer to the descriptions to which I have access; and as the general facies is frequently the most striking generic character, I have, in consequence of the meagreness of my own collection, laboured under the disadvantage of having to identify, in nearly every instance, from the characters as laid down in the books, and these frequently admit of a latitude of construction which the specimens themselves will not justify.

Many of the species whose names stand under the different genera have not been seen, or, at least, not recognised by me; so that the genus has been inferred upon the evidence of the specific description; and when this has not been satisfactory, the species have been allowed to remain where they were first placed by their describers. It may have happened, in a few instances, that the same species has been placed under more than one generic and specific name; and it is not unlikely that some of Mr. Kirby's species have been redescribed, as I did not receive the entomological volume of the Fauna Boreali-Americana in time to study it with the specimens. The names will, however, be found in their proper place in the following pages.

I have followed Dejean's Catalogue throughout, on account of its extent, and the number of North American species noted in it. Unfortunately its author thought it sufficient to catalogue a species to secure the citation of it; an assumption which, if allowed, will require the presence of an American entomologist in Paris (or wherever a catalogue might be published,) before he dare name the insects of his own country. But besides the inability of the world at large to know to what object a mere catalogue name refers, there might be an occasional risk of a species already described appearing under a new name, and of this name being afterwards appropriated to a really new species subsequently described by another author. Moreover, the specimens themselves might be exchanged or displaced, as M. Deshayes asserts to have been the case with Lamarck's shells, of which the labels in this author's own handwriting have ceased to be the best evidence.* Under such circumstances, it becomes impossible that the great body of entomologists should admit the authority of an onerous law, which must place the descriptive portion of the science in the hands of a few, whilst the great majority are converted into mere collectors. Count Dejean does not, in fact, follow his own rule of catalogue priority, many North American Coleoptera having been previously known in Germany, through Professor Knoch, and the Reverend F. V. Melsheimer, in whose catalogue they were named and published, but not characterised, in the year 1806. It is probable that the names given to our insects by Knoch are better known here through the entomologists of German descent, than those of Dejean; and as they have the priority, and the insects themselves are, in many instances, preserved in a national museum,† I have preferred them.

For most of the references to Dejean's Catalogue I am indebted to the kindness of Major John Le Conte, and his son, Dr. John L. Le Conte, from whom that author received many of our species; these gentlemen having placed their collection and drawings‡ at my disposal. The Melsheimer collection was opened to me with equal liberality, by its present possessor, Dr. F. E. Melsheimer. I have, by these means, been enabled to establish a pretty full concordance between Dejean, Say, and Melsheimer; and also between them and the older authors.

The southern localities are mostly due to Professor N. M. Hentz, from whom I received a collection several years ago. Some of these were numbered in accordance with the collection of the Boston Society of Natural History, which has enabled me to make an occasional reference to that collection.§

In the preparation of this paper it was necessary to consult various authorities, and these I have generally cited at length, that those who feel inclined to traverse the same field may be spared the trouble of collecting and arranging this portion of the materials.

* Des envois considérables ayant été adressés au Muséum, on s'empressa de les mettre en ordre, et on rejeta tous les individus de l'ancienne collection qui pouvaient etre remplacés par de plus beaux; on ne fit malheureusement pas attention que les cartons sur lesquels ils etaient fixés, portaient le nom spécifique écrit de la main de Lamarck, et qu'en les ôtant on perdait le moyen de verifier à l'avenir la validité des espèces établies dans ces genres difficiles par ce grand naturalist.—*Lamarck*, VI., 527. *Desh. note.*

† That of Berlin, which contains Knoch's collection, including many North American species received through the elder Melsheimer.

‡ I have admitted several of Dejean's species into my list on the strength of these drawings, adding the size; and, in a few instances, I have added such characters as they appeared to justify.

§ This collection, as I have been informed, has been almost entirely destroyed; and that of Say has shared a similar fate.

Many a one has probably been deterred from entering upon the study of various branches of natural science from the scattered state of the materials, and the consequent difficulty of making a commencement; and unfortunately, the voluminous notes of reference in the possession of those who make special study of peculiar departments are too seldom given to the public, because they are supposed to be within the reach of all. The objects, however, to which the naturalist devotes his attention, have become so multifarious, and are divided to such an extent among different hands, that every assistance which can be afforded must have its value. Species mentioned incidentally should be followed by a reference, and much would be gained if every catalogue were an index.

The North American forms of the Longicornia seem to have a nearer relation to those of Europe than to those of South America; the same genera being mostly found in both regions, to which some of the northern forms are almost entirely confined, as Oberea, Rhagium, Pachyta, Strangalia, and Leptura. The Prionida are most fully represented in the western hemisphere; the genera Elaphidion, Desmocerus, Tetraopes, Dorcaschema, and others, are strictly North American forms, whilst the extensive European apterous genus, Dorcadion, is perhaps entirely unknown here. Among the genera common to North and South America may be mentioned Mallodon, Callichroma, Eburia, Amniscus, Oncideres, Hippopsis, Amphionycha, and Distenia.

The number of species found in Massachusetts, according to Dr. Harris' Catalogue, (1835,) is ninety-one, but there are probably upwards of one hundred now known to inhabit that state. 100

Melsheimer's Catalogue, (1806,) contains one hundred and twenty names, some of which belong to varieties. The species now known to inhabit Pennsylvania may be set down at 132

Species in the United States, ... 270

Species in France, ... 180

Species in England, ... 64

Species common to Europe and North America as follows: 5

Criocephalus rusticus.
Hylotrupes bajulus.
Phymatodes variabilis.
Clytus gazella.
Callidium sanguineum?
Monohammus sutor?
Pachyta sexmaculata.

But as rigid comparisons have not usually been made, and as our own presumed nondescripts could not be readily compared with European analogues, it will probably be found that a number of the latter have been redescribed here, under new names, as in the case of Clytus gazella. Monohammus dentator has been caught alive in England, in 1806, (Tr. Ent. Soc., London, i. 84,) but the occurrence of a single individual is not sufficient to make the species a native.

The following table is intended approximately to indicate the proportion of species contained in a selection of ten European and American genera.

Genera.	France.	G. Brit.	Europe.	Common to Eu. and N. Am.	N. Amer.	Mass.	Penna
Mallodon,			0		4	0	0
Prionus,	1	1	2		8		
Elaphidion,			0		12	4	8
Callidium,	6	7	18	1	9	4	4
Clytus,	15	5	18	1	30	13	13
Dorcadion,	6	0	41		1?*		
Oberea,	4	0	8		8		5
Toxotus,	3	2	5		9	1	4
Pachyta,	7	4	20		9	5	5
Leptura,	13	18	25	1	25	8?	8

PRIONIDÆ.

MALLODON, *Serville.* Ann. Ent. Soc., France, i. 176.

1. M. melanopus, *Lin.* Fabr. Syst. El., ii. 264. Drury, i., pl. 38, fig. 2.

Head thickly pitted above, a deep, transverse groove behind the clypeus; mandibles remarkably robust, carinate above and laterally: prothorax obsoletely denticulate, and subparallel laterally, flattened and minutely punctured above, except along the otherwise absent dorsal line, on each side of which, before the middle, is a large, slightly elevated, smooth facet, sparsely covered with larger punctures than those of the general surface, and bounded anteriorly by a transverse indentation; a larger longitudinal indentation (narrowest before) lies near the outer margin, bounded, exteriorly by a short, smooth, elevated line having a few punctures, and interiorly by a longer one, which extends backwards and inwards towards the posterior margin. 10—18‴ long.

All the North American species of this tropical form appear to be confined to the southern states.

2. M. simplicicolle, *Dupont.* Dej. Cat.

Dark castaneous, approaching to black: head thickly punctured, except along the impressed frontal line; mandibles not remarkably prominent, carinate and thickly punctured above, a strong tooth near the tip: prothorax narrowing anteriorly, finely denticulate anteriorly; dorsal line impressed; upper surface rather regular, with numerous small, scattered punctures, becoming scabrous laterally, and having a slight ridge in the posterior angles, and a short, impressed line posteriorly, converging towards the margin of the scutel: scutel polished, medial line impressed anteriorly, with an irregular row of submarginal punctures. 2″ long.

Var. *bi-impressum.* Bears a close resemblance to the preceding, but differs in having a shallow impression, with an included posterior indentation between the eyes and frontal line; pronotum with the dorsal line indistinct, a shallow fovea before the middle, and nearer to the dorsal line than to the outer margin, bounded exteriorly by an irregular row of large punctures, posterior to which there is a small fovea; posterior impressed lines wanting: metasternum clothed with short, prostrate hair. 18‴ long.

This may be the male of *simplicolle.* The characters are drawn from a single specimen in the cabinet of the Reverend Dr. Morris.

* Monoleima, *Say.*

3. M. SPINIBARBE, *Fabr.*

Bears some resemblance to M. melanopus, but the mandibles are less robust: prothorax narrow anteriorly, and strongly dentate laterally; above with two facets separated externally by a row of deep punctures from an elevated longitudinal line, exterior to which is a similar shorter one curving outwards towards the posterior angle.

11—20‴ long. Inhabits Brazil and the United States.

4. M. DASYSTOMUS, *Say.* Journ. Acad. Nat. Sci., iii. 326.

Prothorax obsoletely denticulate, sides subparallel, convex in the middle; densely punctured above, dorsal line impunctured, a smooth, lozenge-shaped facet each side of it, exterior to which is a longitudinal raised line, interrupted in the middle, another very short one outside of it, and a larger transverse one along the middle of the base.

14‴ long; 4 wide. ♂ Inhabits Carolina in June and July, under oak bark.—Hentz.

ORTHOSOMA, *Serv.* Ann. Ent., i. 154.

5. O. CYLINDRICUM, *F.*, ii. 261. Oliv., pl. 1, fig. 6. Harris, Injurious Insects of Mass., p. 80.

6. O. CILIPES, *Say.* (Prionus.) Journ. Acad. N. Sc., iii. 328. [Mallodon?]

DEROBRACHUS, *Serv.* Ann. Ent., i. 154.

7. D. BREVICOLLIS, *Serv.* Ib. 155. Hab. Georgia. Cab. Le Conte, Hald.

PRIONUS, *Geoff.* Serv. Ann. Ent., i., 191. R. A., pl. 66, f. 4.

8. P. IMBRICORNIS, *Linn.* Pal. Beauv. Ins. pl. 36, f. 2. Car. Jun. Alab.

9. P. BREVICORNIS, F. ii. 260.

10. P. POCULARIUS, *Dalm.* Schœn. Syn., iii. App. 148.

11. P. LÆVIGATUS, *Harris.* Trans. Nat. Hist. Soc., Hartford, i. 83.

12. P. EMARGINATUS, *Say.* Journ. Acad. Nat. Sci., iii., 327.

13. P. PALPARIS, *Say.* Id.

CERAMBYCIDÆ.

PURPURICENUS, *Serv.* Ann. Ent., ii. 568.

14. P. HUMERALIS, *Fabr.* Syst. El. ii. 274. Oliv., pl. 67, fig. 141.

15. P. AXILLARIS.

Black, base, to near the middle of the elytra, brownish-orange. 6—9‴ long. Hab. Pennsylvania.

Lamia axillaris, *Knoch.* Mels. Cat. No. 757.

In size and form this species resembles P. kœhleri of Europe. The scutel is black, the posterior margin of the yellow of the elytra is irregular, and the band narrowest at the suture.

CALLICHROMA, *Latr.* R. A., pl. 65, fig. 8.

16. C. ELEGANS, *Fabr.*, ii. 269. Oliv., pl. 5, fig. 35.

Probably C. splendida, *Dej.* Cat. Fabricius gives "Cajennæ" as the habitat of his species, but Dr. Le Conte has specimens from Georgia.

17. C. SOLITARIUS, *Say.* (Cerambyx.) Journ. Acad. N. Sc., iii. 410.

STENOCORUS, *Fabr.*

18. S. LONGIPES, *Say.* Journ. Acad. Nat. Sc., iii. 426.

EBURIA, *Serv.* Ann. Ent., iii. 8.

19. E. QUADRIGEMINATA, *Say.* Journ. Acad., v. 275.

CERASPHORUS, *Serv.* Ann. Ent., iii. 10.

20. C. GARGANICUS, *Fabr.* Syst. El., ii. 305. Harris, 81.

21. C. QUADRISPINOSUS.

Pale yellowish-brown, scutel with yellowish hair, elytra immaculate.

C. quadrispinosus, Dej. Cat. Boston Collection, No. 559? Size and appearance of C. garganicus. In Dr. Le Conte's specimen there is a little tubercle on each side of the pronotum behind, which is wanting in mine. The larva lives in the sound wood of trees of the genus Carya, the perfect insect appearing in the spring. Inhabits Pennsylvania, where I have found but a single individual: also Carolina and Alabama, according to Mr. Hentz.

ELAPHIDION, *Serv.* Ann. Ent. iii. 66.

22. E. PULVERULENTUM, *Lin.* Gm. p. 1857, No. 306. Mels. Cat. 791.

14‴ long, 4¼ wide. Black, uniformly covered with dull, olivaceous, prostrate hair: a short, narrow facet along the dorsal line: elytra with a reddish reflexion. Enaphalodes leconteï? *Dejean.*

23. E. MARILANDICUM, *F.*, ii. 306. Oliv., iv., pl. 70, fig. 5. Drury, i. pl. 41, fig. 6—multicolor? Turton, L. ii. 334.

11—12‴ long; 3—3½ wide. Inhabits Massachusetts: Pennsylvania, in July: Carolina, June—September. Flies at night. This is our largest species, with the exception of the preceding. The colour is dark-reddish-brown, covered with scattered tufts of short gray hair: pronotum scabrous, with numerous dilated punctures; a circular or elongate facet along the posterior portion of the dorsal line, and a small facet upon each side before the middle, the three forming an equilateral triangle. Elytra strongly punctured. The frontal line is impressed or obsolete, and the dorsal facets are sometimes wanting.

24. E. RUFULUM.

General appearance of *marilandicum:* rufous, with a tolerably uniform clothing of pale, ochraceous hair: antennæ ochraceous: a small tubercle each side of the dorsal line, which latter suddenly widens into a triangular facet near the posterior margin.

11‴ long.

25. E. ASPERSUM.

Robust, reddish-brown, thickly sprinkled with small whitish spots; antennæ slightly armed; prothorax subglobular, transverse; femora subclavate.

8‴ long; 2 wide. Cab. Le Conte.

Head large, frontal line impressed, and continued as a smooth line over the vertex; antennæ rather robust, clothed with short prostrate hairs, and slightly armed from the third to the sixth or seventh articulation: prothorax pretty uniformly clothed, median line smooth and polished, bi-abbreviated, and widest posteriorly, a smooth tuber-

cle each side before the middle, in contact with a small tuft anterior to it; two or three tufts towards the posterior angles: scutel concave, clothed with flavous hair: elytra with rather fine, dilated, impressed punctures, and small, irregularly scattered tufts over the entire surface.

Allied to *vicinum* and *nebulosum*.

26. E. TRUNCATUM.

Robust; reddish-brown, thickly and finely sprinkled with tufts of whitish hair; elytra short, subparallel, mutic, and slightly truncate at tip.

6‴ long; 1¼ wide. Cab. Melsheimer.

Mandibles black, palpi rufous, post-clypeus with whitish hair extending in a narrow line to the inner base of the antennæ; frontal line obsolete; antennæ yellowish-brown, shorter than the body, third, fourth, and fifth articulations slightly armed: a conspicuous whitish dot at the anterior edge of the pronotum, and a single one upon the middle of each side; dorsal facet very short, widest posteriorly: elytra very slightly truncated, and having a minute sutural spine.

Intermediate between *aspersum* and *villosum*.

27. E. MURICATUM.

Reddish-brown, very slightly dotted; head large, spines of the antennæ very large, that of the third articulation nearly equalling the fourth articulation in length.

6‴ long; 1⅓ wide. Carolina, Massachusetts.—Hentz.

Stenocorus muriaticus? Say. *Hentz.* Boston Coll., 562. Antennæ with three or four of the articulations armed: prothorax as wide as long, dorsal line smooth, with two indistinct tubercles on each side: elytra mucronate.

Characterized from a very imperfect specimen received from Professor Hentz, with the above name and reference. Not having noticed the trivial name among Say's papers, it is possible that the citation was made from memory, with *mucronatus* in view. It may eventually prove to be Say's *rigidus*.

28. E. VICINUM.

Reddish-brown, femora mutic, spines of the third, fourth, fifth and sixth articulations of the antennæ very short.

9‴ long; 2¼ wide. Inhabits Pennsylvania.

Mandibles and eyes black; antennæ hairy; front concave; a tuft of hair between the eyes, and extending along the orbits above: prothorax transverse, a small yellowish spot of hair laterally, numerous dilated punctures above; dorsal line a wide, smooth ridge slightly bi-abbreviated, widest posteriorly, and narrowed in the middle, so as to be almost interrupted; four facets above arranged in a quadrangle, two small circular ones before the middle, and two short, linear, longitudinal ones slightly converging backwards to the posterior margin: scutel yellowish, with dense hair: elytra subparallel, with small scattered tufts of yellowish hair, and numerous dilated impressed punctures, arranged in tolerably regular series, and becoming obsolete on the apical third; apex separately emarginate and bi-spinose, exterior spine longest.

Allied to *mucronatum*, but the external, apical angles of the elytra are more suddenly rounded, the femora mutic, and the antennæ armed with much smaller spines. It is a rather robust species, with a large prothorax.

29. E. MUCRONATUM, *Say.* Journ. Acad. N. Sc., iii. 427. E. nebulosum, *Dej.* Mels. Cat., 750.

Antennæ robust, three—four spined, first spine two-thirds the length of the following articulation: elytra tapering rather rapidly towards the tip: femora bi-mucronate at tip.

7‴ long; 2 wide. Inhabits Pennsylvania.

Allied to *villosum*, but distinguished by the greater size, tapering elytra, mucronate femora, and armature of the antennæ, the spines being larger than in any of the species I have seen, except in *muricatum*.

Var. *vestitum*. More thickly clothed, rather smaller, and with the elytra but slightly tapering towards the apex. Pennsylvania—June.

30. E. VILLOSUM, *Fabr.*, ii. 311. E. putator, *Peck*. Harris, Injurious Ins. of Mass., 81. E. villosum? and pruinosum? *Dej.*

The larva feeds upon the living wood of the genera Quercus, Carya, and Castanea; and, in one instance, I raised an individual, apparently of this species, from a larva taken from the dead trunk of a small abies. It appears in Pennsylvania in May and June.

31. E. PUSILLUM.

Reddish-brown; uniformly and sparsely clothed with short, prostrate, yellowish hair; prothorax longer than wide, swelled laterally; elytra elongate, parallel, each with a narrow emargination. $5\frac{1}{2}'''$ long; $1\frac{1}{4}$ wide.

Antennæ pale-rufous, armature feeble; dorsal line, and an additional one, each side of it, obscurely marked with yellowish down; scutel yellowish: elytra slender, parallel, outer posterior angle obliquely truncate; tip narrow; finely emarginate, with a short, equal, sutural, and external spine: beneath, and feet, dull rufous.

An individual, numbered 746 in Melsheimer's Catalogue, which I believe to belong to this species, is there named *bidens*, of Fabricius, but it differs from the latter, as characterised, in wanting *two* spines to each articulation of the antennæ, besides being much more slender than the insect, as figured by Olivier. I am not acquainted with any species possessing this peculiarity. The Melsheimer specimen is a little more than six lines long, and has a few small scattered tufts of hair upon the elytra.

32. E. RIGIDUS, *Say*. (Stenocorus.) Journ. Acad. N. Sc., V. 274.

33. E. BIDENS, *Fabr*. Oliv., pl. 17, Capr. fig. 125. Encyc., V. 306. "Antennarum articulis bispinosis." "Il ressemble beaucoup au *spinicorne*. (Oliv., pl. 17, fig. 130.) Les antennes sont testacées, un peu plus longues que le corps, munies de deux petites épines à l'extrémité de chaque article."—*Encyc.*

*ANOPLIUM.

Like Elaphidion, but having the antennæ and elytra unarmed, and the pubescence uniform.

34. A. PUBESCENS.

Pale yellowish-brown, robust, subcylindric, elytra nearly parallel, entire at tip.

7''' long; 2 wide. Inhabits Pennsylvania.

Stenocorus pubescens, Mels. Cat., No. 751. Head pubescent, with an impressed longitudinal line throughout; eyes and tip of the mandibles black: prothorax with a smooth lateral indistinct tubercle, and one upon the dorsal line behind the middle: scutel triangular, yellow pubescent: elytra covered with impressed punctures, which are particularly obvious at the base: femora mutic.

35. A. UNICOLOR.

Slender, reddish-brown, with a sparse and very uniform clothing of yellowish hair.

4—6''' long; 1 wide. Inhabits Pennsylvania.

Saperda unicolor, No. 781, and S. scutellata, No. 779, Mels. Cat. Antennæ slender, basal articulation slightly curved, frontal line impressed between them: prothorax with the sides projecting, and having a tendency to form an angle in the middle: scutel yellowish, concave: elytra sparsely clothed, the hairs arising from numerous impressed punctures; tip obsoletely emarginate.

Distinguished by its slender form, uniform tint, and slightly emarginate elytra.

TRAGIDION, *Serv.* Ann. Ent., iii. 89.

36. T. LYNCEUM, *Fabr.* Syst. El., ii. 344. Ent. Syst., ii. 329. Oliv., pl. 14, fig. 97. Coquus, *Fabr.*, ii. 300. Melsheimeri, *Germar* Species.

The transverse band near the base of the elytra is sometimes interrupted at the suture so as to leave two fulvous spots. Professor Germar (Revue Zool., 1839, p. 330,) refers his specimen to the genus Anoplistes, *Serv.*, Ann. Ent. Soc., France, ii. 570, probably because the armature of the prothorax cannot be readily distinguished through the dense clothing of hair.

CALLIDINÆ.

CRIOCEPHALUS, *Mulsant.* Longic. de France, p. 63.

37. C. AGRESTIS, *Kirby.* (Callidium.) N. Z. 170.

Dull brownish-black, beneath black with cinereous pubescence; pronotum with three conspicuous foveæ.

10‴ long; 2 wide. Inhabits Maryland and Virginia.

Criocephalum foveicolle, Dejean Cat., p. 354. Head with a deeply impressed line between the antennæ: pronotum flattened: posterior two-thirds of the dorsal line impressed, and spreading laterally so as to form a wide furrow, somewhat foveolate near the posterior margin; a large conspicuous fovea or indentation upon each side of the dorsal line and lateral limb, and a slight inconspicuous impression in the posterior angles: elytra with three longitudinal ribs; one medial, the second intermediate between this and the suture, and the third submarginal; the marginal space being narrowest, and the submarginal one widest; the outer and inner costæ curve towards each other and meet near the apex of the elytra, and near this angle the medial costa curves to the inner one; a very short, obsolete, subsutural costa joins the scutel.

38. C. RUSTICUS, *Fabr.* C. obsoletum, *Randall.*

Dorsal marks and elytral costæ obsoleto, scutellar costæ upon the suture.

9—10‴ long. Inhabits Europe and North America.

ASEMUM, *Esch.* Serv. Ann. Ent., iii. 79.

39. A. MŒSTUM.

Black, finely scabrous; elytra striate, with the intervals elevated into costæ.

6‴ long; 1¾ wide. Inhabits Pennsylvania.

Head finely punctured, a wide indentation between the antennæ: prothorax brownish pubescent; with a wide, faint, dorsal fovea: elytra with two approximate elevated medial costæ, meeting posteriorly, an indistinct one between these, another upon the suture, and a submarginal one obsolete anteriorly: scutel with a medial impressed line.

VAR. *obsoletum.* Striæ and Costæ of the elytra indistinct. Cab. Le Conte.

VAR. *brunneum.* Pale-brown. Cab. Le Conte.

This species is probably allied to *striatum*, of Europe.

40. A. SUBSTRIATUM.

Black, punctured, slightly pubescent; elytra indistinctly striate, with about three inconspicuous costæ.

6‴ long. Inhabits Massachusetts.

Callidium substriatum, *Germar*, MS. Bost. Coll. 576. Prothorax subequal, narrowed anteriorly: elytra with the sides regularly convex, and having three obsolete approximate central costæ, the outer ones united posteriorly.

41. A. JUVENCUM.

Dull reddish-brown; prothorax transverse, dilated laterally, a large fovea upon each side above; elytra obsoletely striate, dull fulvo-sericeous.

7‴ long; 2 wide. Cab. Le Conte.

Criocephalum juvencum, *Dej.* Cat. Head slightly clothed with short hair; antennæ very short; front slightly indented between the antennæ, mandibles and tip of the palpi black: prothorax inflated laterally, sides very convex, minutely scabrous, partially clothed, especially in the foveæ: under parts polished.

Closely allied to *substriatum*, but the prothorax is rather wider than the base of the elytra, whilst in that species it is slightly narrower, and converges forwards in a straight line, corresponding with the sides of the head.

42. A. FUSCUM.

Testaceous, eyes black, metasternum and postcoxæ piceous; prothorax equal; elytra parallel, with obsolete elevated lines.

4‴ long. Inhabits Pennsylvania.

Callidium fuscum, *Mels.* Cat., No. 820.

HYLOTRUPES, *Serv.* Ann. Ent., iii. 77.

43. H. BAIULUS, *Lin.* Fabr. Syst. El., ii. 33.

Inhabits Europe and America.

VAR. *bullatus.* Shining black; head large; prothorax very large, transverse; elytra very pale yellowish-brown, translucent. 8‴ long; 2¾ wide.

General character of H. bajalus, but may be distinct. The elytra are discoloured, and the head and prothorax abnormally enlarged. The dorsal facets are also larger. It is clothed with a similar white down, including the tufts upon the elytra. Characterized from a female in Mr. Le Conte's cabinet.

ARHOPALUS, *Serv.* Ann. Ent. iii. 77.

44. A. FULMINANS, *Fabr.* Syst. El., ii. 346. Angulatus, *F.*, ii. 350.

CALLIDIUM, *Fabr.* Serv. Ann. Ent., iii. 77.

45. C. ANDREÆ.

Rubro-testaceous, elytra varied with black; antennæ black, varied with reddish: head one-half the diameter of the thorax, medial line beneath, black: frontal line impressed: pronotum flattened; posterior angles with a large, prominent tubercle, having a wide depression anterior to it; an obsolete medial tubercle anteriorly: elytra flattened; humeri very prominent; three curved elevated lines, the two exterior ones interrupted; anterior por-

tion of the intermediate one rectilinear and oblique, confluent with the interior one, which is the shortest, all of them abbreviated at one-third the distance from the apex of the elytra: clavus of the femora blue-black.

10 lines long; 3 wide. Georgia. Cab. Le Conte.

Belongs to the genus Physocnemum. Named by Dejean from the resemblance the lines on the elytra bear to a St. Andrew's cross.

46. C. VIOLACEUM, *Lin.* Fabr. Syst. El., ii. 335. Harris, p. 83.

Judging from drawings in the possession of Mr. Le Conte, I think C. cyanellum and ianthinum, *Dej.*, are varieties of this species.

47. C. LIGNEUM, *Fabr.* Syst. El., ii. 341. Oliv., pl. 70, fig. 79.

48. C. AMŒNUM, *Say.* Journ. Acad., iii. 413. (Phymatodes variabilis?)

49. C. FULVIPENNE, *Say.* Journ. Acad., iii. 414. [Purpuricenus, *fide* Le Conte.]

50. C. PROTEUS, *Kirby.* (Merium.) N. Z. 172. [Hylotrupes, *fide* Le Conte.]

51. C. SIMILIS, *Kirby.* (Merium.) N. Z. 173.

52. C. VARIUM, *Fabr.* Syst. El., ii. 345. Oliv., Ent. IV., pl. 70, fig. 55. Versicolor, Turton, L. ii. 329.

This species has the short antennæ of Callidium, and approaches the next genus by the three smooth tubercles above.

53. C. PALLIPES.

Uniform yellowish-brown, pilose; feet and beneath much paler; femora clavate.

4½‴ long; 1½ wide. Inhabits Pennsylvania—New York.

Callidium femoratum, Mels. Cat. No. 817.

54. C.? SEXFASCIATUM, *Say.* Journ. Acad. N. Sc., iii. 415.

Inhabits Alabama in June—on leaves?—Hentz.

55. C. DIMIDIATUM, *Kirby.* (Merium.) N. Z. 177.

56. C. CINNAMOPTERUM, *Kirby.* (Tetropium.) N. Z. 174.

PHYMATODES, *Mulsant*, p. 47. MERIUM, *Kirby.*

57. P. VARIABILIS, *Lin.*, fenicum, *F.*, ii. 334. M. C., No. 802.

A well known European species. It presents several marked varieties, and is found from Massachusetts to Alabama. Callidium fuscum, Mels. Cat., No. 820, is a small variety, of an ochraceous colour.

VAR. *ventralis.* Testaceous; head above, eyes, metathorax, and three basal articulations of the abdomen black.

Allied to the variety P. testaceus, *Lin.* Inhabits Alabama.

*TYLONOTUS. (< Mallocera.)

Body minutely scabrous, convex; antennæ slightly hairy, robust, tapering rapidly, at least as long as the body, *compressed*, with a *groove* upon the anterior edge from the third articulation, which is the longest, exceeding the first and second conjointly; pronotum subglobular, with polished *tubercles;* elytra unarmed; femora incrassated.

The facies is that of Elaphidion, whilst it differs from Phymatodes in the antennæ, and in having a larger head.

58. T. BIMACULATUS.

Castaneous, dorsal line and a tubercle on each side of it polished, a corneous macula at the tip of the elytra. 7‴ long; $1\frac{3}{4}$ wide. Inhabits Pennsylvania.

Head finely scabrous, frontal line impressed: prothorax subglobular, minutely scabrous: scutel semicircular: elytra with numerous impressed punctures, a large corneous macula at the tip of each, and a small, obsolete one before the middle: femora incrassated, with a broad band of pale corneous yellow: tarsi pale ferruginous, hairy: metasternum and abdomen dull testaceous.

All the parts have a thin clothing of hair. Described from a single individual which was cut from a decayed Fraxinus, in July.

*SMODICUM, *Dej.* Cat.

Body slender, much depressed, polished, and minutely punctured; head and mandibles prominent, eyes projecting; antennæ subfiliform, shorter than the body; prothorax flat, longer than wide, sides convex; *prosternum* with a large, reniform *excavation* upon each side anteriorly: elytra parallel: femora incrassated.

59. S. CUCUIFORME, *Say.* (Callidium.) Journ. Acad., v. 277. Mels. Cat., No. 800. S. melanophthalmum, *Dej.*

Inhabits Massachusetts, Pennsylvania, (July,) and Carolina, (June, July,) under oak bark, and flies at night. The shallow excavations in the prosternum are scabrous, and without the gloss reflected from every other part.

*PHYSOCNEMUM.

Prothorax subglobose, narrowed posteriorly, tomentose, except the dorsal line, and two slight tubercles behind the middle above: palpi slightly securiform; antennæ eleven jointed, longer than the body, and setaceous in the male, as long as the body and almost filiform in the female: elytra flat above, scabrous punctate, with smooth, raised costæ, of a pale colour; base nearly square, with the angles projecting, sides compressed towards the middle; tips gaping and separately *obtusely rounded:* femora *clavate.*

Apparently closely allied to the genus Anaglyptus, *Mulsant*, p. 91, but differs in having all the thighs clavate.

60. P. BREVILINEUM, *Say.* (Callidium.) Journ. Acad., iii. 413. C. antiquum, *Dej.*

Pennsylvania and Arkansas. Of the two individuals in Dr. Melsheimer's cabinet, one has setaceous antennæ, and the elytra tapering, as in Agrilus; in the other, they are shorter, and nearly filiform, and the elytra do not taper towards the extremity. Notwithstanding these differences, the facies is so similar that I think the two may be regarded as opposite sexes of the same species. The length of what I suppose to be the male and female, is about five and four lines respectively.

*STENOSPHENUS, *Dej.* Cat.

Head small, antennæ setaceous, shorter than the body in the females, and longer in the males, most of the articulations *spinose* at tip; prothorax smooth, subglobular, and *mutic:* scutel semicircular: elytra tapering, *bi-spinose* at tip: femora slightly incrassated.

Facies of Callidium, with the spinose antennæ and elytra of Elaphidion.

61. S. NOTATUS, *Oliv.*, iv., tab. 7, fig. 89, discicollis, *Dej.* Cat., 355.

The black spot upon the pronotum varies from a large to a small size, and is frequently absent. Inhabits Pennsylvania. Washington, Carolina, April.

ERIPHUS, *Serv.* Ann. Ent., iii. 88.

Allied to Stenosphenus; body punctured and hairy; palpi truncate, antennæ filiform, shorter than the body, very slightly armed; feet slender, femora not thickened; elytra rounded at tip, and unarmed.

62. E. IGNICOLLIS, *Say.* (Callidium.) Journ. Acad., iii. 412, anno 1823,—sanguinicolle, *Germar.* Sp. nov., p. 515, anno 1824.

63. E. COLLARIS, *Kirby.* (Callidium.) N. Z. 171.

64. E. SUTURALIS, *Say.* Journ. Acad., iii. 411,—miniatum, *Germar.* Sp. nov., 515. Eriphus rubens, *Dej.*

Occurs with the antennæ and feet rufous; and without the sutural band. In the latter case, it is E. rubens, Dej. Cat.

65. E. DISCOIDEA, *Say.* Journ. Acad., iii. 411.

A specimen in Dr. Melsheimer's cabinet has the head rufous, and the anterior and intermediate femora pale-rufous.

66. E. COCCINEICOLLIS. (Eriphus.) Dej. Cat.

Sanguineous, antennæ black, elytra deep, shining blue, punctured, *femora clavate.* 3‴ long; ¾ wide.

At first view appears to be a small individual of E. ignicollis, *Say*, but the general colour is uniform, and it has the femora clavate.

CLYTUS, *Fabr.* Serv. Ann. Ent., iii. 83.

67. C. SPECIOSUS, *Say.* Am. Entomology, pl. 53. C. hayii, *Gray.* Griff. Cuv.

68. C. CHARUS, *Say.* Boston Journ. Nat. Hist., i. 193. Inhabits Indiana.

69. C. DECORUS, *Oliv.*, pl. 70, fig. 92. Inhabits Georgia.

70. C. ROBINIÆ, *Forster*, 1771, flexuosus, *F.*, 1775. Harris, 85. Mich. Am. Sylva., i. pl. 35, f. 3.

71. C. NOBILIS, *Harris*, Hartford Trans., i. 84, pl. 1, fig. 7.

72. C. ERYTHROCEPHALUS, *F.* Syst. El., ii. 350. Oliv., pl. 70, fig. 60, 60, *b.*

Inhabits Carolina, Virginia, Pennsylvania, Massachusetts, April—September. 3½—7‴ long.

M. Serville makes this species the type of the genus.

73. C. LUSCUS, *Fabr.* Syst. El., ii., 347. C. aculeatus, *Dej.* Carolina, June—August.

74. C. SCUTELLARIS, *Oliv.*, iv. pl. v. fig. 52. Encyc., v. 267.

Black, pronotum obtusely carinate, with a narrow, transverse medial, and an anterior and posterior narrow, yellow band; elytra with the base rufous, and having two obliquely curved, and one transverse yellow band. $5\frac{1}{2}'''$ long; $1\frac{1}{2}$ wide. Hab. Pennsylvania, Virginia, July—Carolina, June.

C. elegans, *Mds.* Cat., 812. Boston Collection, 573. Head surrounded posteriorly with a narrow, yellow band; front with two vertical yellow bands; antennæ rufous: elytra tapering rapidly; tip obliquely truncate, with a spine exteriorly; first elytral band curving obliquely outwards from the scutel to the margin, when it extends forward along the side, the second curves in an inverse direction from the margin to the suture about the middle, and the third is midway between this and the tip: feet slender, rufous, femora elavate, extremity black, the posterior ones extending beyond the elytra: venter with four broad, yellow bands.

The curved lines on the elytra present the appearance of four separate quadrants placed together, with the convexity inwards.

75. C. PUBESCENS, *Dej.* Cat.

Uniform dull reddish-brown, sparsely covered throughout with yellowish hairs; elytra conjointly emarginate, with a spine at tip, externally. 6—8‴ long. Hab. Pennsylvania. ♂ Cab. Melsheimer. ♀ Cab. Le Conte.

Head with a wide frontal groove: prothorax large, tapering very gradually forwards, scabrous and transversely rugous above, without dorsal line: elytra tapering rapidly, minutely rugose, with confluent punctures, and ending in a spine near the outer margin; sutural hairs sufficiently dense to form a light-coloured line which is crossed by two others, at a third of the distance from the base and apex, and there is another line of hair in a short, humeral impression: feet and beneath hairy, femora extending a little beyond the elytra.

76. C. GRAMINEUS, *Klug.*

Dull brown, cinereous hairy beneath; elytra with several indistinct yellowish irregular transverse lines, apex truncate-emarginate, with a small spine towards the external side. 6‴ long; 2 wide. Inhabits Oregon.

Body short and robust, pronotum transversely rugulose, widest behind the middle, whence it narrows suddenly and obliquely to the base of the elytra. Cab. Le Conte.

77. C. VESPOIDES, *Dej.* Cat.

Reddish-brown, base of the antennæ, feet, and base of the elytra rufous; prothorax subglobose, anterior and posterior margins, with the scutel, yellow; four transverse yellow bands. 5‴ long; $1\frac{3}{4}$ wide. Georgia.

Robust, metathorax with a yellow spot laterally: segments of the venter margined with yellow: elytra with the basal band interrupted, the second directed obliquely outwards and backwards, and placed before the middle, the third one-fourth the distance from the apex, the fourth apical. Cab. Le Conte.

This species, as well as others noticed in this paper, may be figured in the monograph of Castlenau and Gory on this genus, a work which I have not seen.

78. C. CAMPESTRIS, *Oliv.*, iv. pl. 70, fig. 95. Id., villicus? fig. 94—colonus? *Fabr.* Syst. El., ii. 345. Encyc., v. 259.

The larva does considerable damage to fallen chestnut timber, which is extensively used in the construction of fences. The younger individuals burrow between the bark and the wood, where the larger ones are also found, but in general they penetrate beneath the surface. The perfect insect appears in May and June, and has been found from Massachusetts to Carolina and Mississippi.—Bost. Coll., 579.

79. C. RHOMBIFER, *Oliv.*, pl. 70, (4) fig. 51. *a. b.* Georgia.

80. C. CAPREA, *Say.* Ann. Ent., pl. 53. Mass., Penna., Virginia, Missouri, New Orleans.

81. C. GAZELLA, *Fabr.*, ii. 348. C. hamatus, *Say.* Am. Ent., pl. 53.

A European species, taken near the Illinois river, by Say. Another specimen was taken by Mr. Hentz, in Alabama? and Say's name is quoted in Harris' Catalogue.

82. C. UNDULATUS, *Say.* Am. Ent., pl. 53. Kirby, N. Z., 175, pl. 7, fig. 5.

North-west Territory.

VAR. *integer.* Undulated line upon the elytra obsolete.

An individual in Dr. Melsheimer's cabinet, taken in Pennsylvania.

83. C. LUNULATUS, *Kirby*, N. Z., 175.

Black, pronotum with an anterior and posterior whitish band; elytra with a basal spot and three bands whitish. 5‴ long; 1½ wide.

VAR. *capreolus*, Dej. Cat.

The markings of Say's figure of *undulatus* represent those of this variety very accurately.

84. C. 4-MACULATUS.

Black, elytra pale yellowish-brown, pronotum with a yellow macula in each angle. 5‴ long. Inhabits Pennsylvania.

C. 4-maculatum, Mels. Cat., No. 813. Head black, with raised frontal and short orbital lines: antennæ, feet, and abdomen piceous: prothorax minutely scabrous, equally narrowed towards both extremities, a conspicuous tomentose, pale-yellow spot in each of the four angles above, another upon the margin of meso-sternum, and similar ones upon the lateral posterior margin of the first and second segments of the abdomen.

85. C. FUSCUS, *Kirby.* N. Z., 176.

86. C. LONGIPES, *Kirby.* N. Z., 176.

87. C. MURICATUS, *Kirby.* N. Z., 177.

88. C.? DENTIPES, *Oliv.*, iv. pl. 70, fig. 40. Encyc., v. 268.

89. C.? CONFUSUS, *Say.* Journ. Acad. Nat. Sc., v. 276. Lamia, id. Harris Cat., p. 51.

90. C. ANNOSUS, *Say.* Journ. Acad. Nat. Sc., v. 277.

91. C. PALLIATUS, *Harris* Cat.

Rufous, head and pronotum black, posterior half of the elytra blackish-brown. 3‴ long; 1 wide. Inhabits Massachusetts.

Frontal line impressed, palpi and antennæ rufous: pronotum minutely scabrous, with numerous punctures, except at the posterior extremity of the dorsal line: scutel covered with cinereous hairs: elytra parallel, densely punctured, obtusely rounded at tip: femora clavate.

92. C. VERRUCOSUS, *Oliv.*, pl. 8, fig. 98, gibbosus? *F.*, obliquum, *Knoch.* Mels. Cat., No. 814.

The mesosternum and basal half of the elytra vary from black to rufous. Inhabits Massachusetts, Pennsylvania, Carolina.

93. C. PINIADEUS, *Fabr.*, ii. 353, pini, *Oliv.*, pl. 8, fig. 105. (C. picipes? Var.?)

VAR. *testaceipes.* Head, antennæ, prothorax, and feet testaceous; elytra with an additional light, oblique line upon the pale-brown of the extremity. Carolina, March—June.—Bost. Coll., 585.

94. C. PICIPES, *Fabr.* Syst. El., ii. 353. Oliv., pl. 70, fig. 43. Encyc., v. 269.

Black, pronotum longitudinally rugose; elytra with an oblique white line: third and fourth joints of the antennæ tipt with a spine. Three lines long.

95. C. GEMINATUS.

Dark-brown, head and prothorax black, minutely scabrous; elytra with an oblique whitish line near the apex, and a geminate one, forming a flattened oval near the base; femora clavate. $2\frac{1}{2}'''$ long. Inhabits Penna.

Allied to *picipes* and *pinicadeus*. The anterior side of the oblique oval on the elytra is formed by an elevated line; antennæ and feet varying from yellowish-brown to piceous.

96. C. GAZELLUTA.

Minutely scabrous, pale-brown, pronotum darker, lengthened, narrowed behind: antennæ filiform, and with the under parts dull testaceous: elytra with the apex, two spots near the base, and a medial transverse band, white tomentose. Three lines long. Inhabits Pennsylvania.

97. C. SUPERNOTATUS, *Say*. Journ. Acad., iii. 425. C. minutissimus, *Dej*.

Scutel whitish, and with two light spots on the elytra, finely tomentose. 5—7 mm. long. Inhabits Massachusetts, Harris: Missouri, Say: Pennsylvania, June: Carolina, March—June.—Hentz.

Presents much the appearance of a minute Saperda.

98. C. PYGMÆUS.

Dark-brownish testaceous; front convex; antennæ annulate, with one or two spines or hairs at the apex of the articulations: head continuous with the prothorax, which is wedge-shaped, widest before, with the sides rectilinear: feet strongly clavate. $1'''$ long. Inhabits Pennsylvania.

Callidium pygmæum. *Mels.* Cat., No. 821.

Remarkable for its minute size, and the great latitude of the head and adjoining portion of the thorax. Characterized from an imperfect individual in Dr. Melsheimer's cabinet.

*DIOZODES.

Body oblong, depressed, shining: head porrect, terminal articulation of the maxillary palpi cylindrical, and truncate at tip; eyes prominent; antennæ eleven-jointed, almost filiform, very slender, base rather long and enlarging outwards, second articulation short, narrowed at base, third *shorter* than the first, fourth slightly *longer* than the third, fifth longest, the remaining ones gradually shorter to the extremity, prothorax with a transverse groove at each extremity, depressed, longer than the head, much contracted posteriorly, the sides *projecting into a large tubercle* before the middle: elytra with piliferous punctures, widening posteriorly, and conjointly rounded at tip: femora clavate: first and second segments of the abdomen entirely confluent.

99. D. PALLIDA, *Say*. (Callidium.) Journ. Acad. Nat. Sc., iii. 412. Rhagium nitidum. *Mels.* Cat., No. 790. Boston Soc. Collection, No. 815. Obrium lepidum, *Dej*.

Inhabits Arkansas, Pennsylvania; and Carolina, (June,) on Castanea pumila.

OBRIUM, *Serv.* Ann. Ent., iii. 93.

100. O. RUFULUM, *Dej*. $2\frac{2}{3}'''$ long.

101. O.? DEJEANII, *Le Conte*.

$3'''$ long. Olivaceous, elytra abbreviated.

*NOTHRUS. (Plectrocerum? *Dej.*)

Body slender; *antennæ* setaceous, longer than the body, fringed beneath with a row of fine hairs, scapus enlarging rapidly to the apex, pedicellus one-fourth the length of the third articulation, which is equal to the fourth, fifth longest, eleventh shorter than the penultimate: prothorax elongate, sides continuous with the head, slightly convex, suddenly diminished posteriorly; a wide depression along the dorsal line: scutel rounded at tip: elytra parallel, flattened above, apex conjointly rounded: feet slender, femora clavate. Facies of Ancylocera.

102. N. FUSCUS.

Pale-brown, slightly reddish beneath, eyes black. $2\frac{1}{2}'''$ long; (elytra $1\frac{1}{2}$,) $\frac{1}{4}$ wide. Cab. Le Conte.

Antennæ slightly hairy: pronotum with a broad depression along the dorsal line, which widens and turns outwards posteriorly; and with the elytra clothed with short prostrate hair: femora strongly clavate.

PLECTROMERUS, *Dejean.*

103. P. DENTATUS, *Le C.* Ann. Lyc. N. York, i. 172, pl. 11, fig. 11.

104. P. CONCINNATUS, *Dej.*

$2\frac{1}{2}'''$ long. Pale-brown, elytra with three longitudinal darker spots; femora mutic.

HETERACHTHES, *Newman.* (IBIDION, Dej. Cat.)

Body slender, prothorax cylindrical, twice as long as the head, narrowed posteriorly: *antennæ* eleven-jointed, setaceous, and as long as the body in the female, first joint double the thickness of the remainder, second minute, subglobular, third considerably the longest; and most of them slightly thickened at the end; in the *male*, first and second as in the female, third thicker than the first, and with the fourth, fifth and sixth *cylindrical, rounded* at both ends, seventh and succeeding ones *suddenly reduced* in thickness, and resembling those of the female; slightly fringed beneath in both sexes: scutel rounded: elytra slender, mutic: extremity of the femora incrassated.

105. H. 4-MACULATUM.

Testaceous, two yellow circular spots near the middle of the elytra. 4—5 lines long. Hab. Pennsylvania: Carolina in July.

Rhagium 4-maculatum. Mels. Cat., 789. Boston Coll., No. 741.

A slender insect, with prominent eyes projecting beyond the prothorax, the latter with a wide, shallow transverse groove before the middle, and another at the posterior extremity; elytra with piliferous punctures.

VAR. *pallidum.* Pale, posterior spots wanting. Three lines long.

106. H. EBENUS, *Newman*, dimidiaticorne, *Dej.*

Very slender, uniform atropurpureous; head and prothorax minutely granulate; dorsal line smooth; elytra with a slight humeral depression. $4\frac{1}{2}'''$ long; $\frac{3}{4}$ wide.

STIZOCERA, *Serv.* Ann. Ent., iii. 107.

Body slender, subcylindric, with numerous impressed punctures: head large, eyes deeply emarginate and prominent, antennæ as long as the body, setaceous, articulations cylin-

drical, slightly thickened at tip, third longest, subsequent ones subequal, tip of the third and several of the succeeding ones *with a spine;* palpi with the terminal articulation obconic, truncate: prothorax cylindrical, narrower than the head and elytra, and double the length of the head: elytra subparallel, punctate scabrous, tipped each with two spines: feet long and slender.

In the armature of the antennæ and elytra this genus approaches Elaphidion; and Ibidion in form.

107. S. UNICOLOR, *Randall.*

Pale-yellowish testaceous, elytra paler; eyes black, coarsely reticulate. $4\frac{1}{2}'''$ long. Hab. sea coast of Virginia. Bost. Coll., No. 564.

Ibidion plochionoecrum, *Dej.* Head with numerous impressed punctures, prominent between the antennæ, two little tubercles in front of this, medial line fine, obsolete on the vertex, where the punctures are smaller and less crowded; inner edge of the mandibles black: prothorax with a slight, transverse, impressed line at each extremity; sparsely punctured, and having a few hairs: elytra irregularly and coarsely punctate, having a small, sutural spine, and a larger one at the external angle: feet slender, femora thickened beyond the middle.

IBIDION, *Serv.* Ann. Ent., iii. 103.

108. I. LINEARIS, *Dejean* Catalogue.

ANCYLOCERA, *Serv.* Ann. Ent., iii. 107.

109. A. RUGICOLLIS, *Fabr.* (Gnomo.) Syst. El., ii. 317. Saperda bicolor, *Oliv.*, iv. pl. 3, f. 25.

110. A. LIVIDIPENNIS, *Le Conte.*

Black, elytra yellow. 6‴ long.

STENOPTERUS, *Illig.* Serv., Ann. Ent., ii. 545. R. A., (Ed. nov.) pl. 66, *b.* fig. 2.

111. S. RUFUS, *Lin.* Harris, Cat. Fabr., ii. 372. Oliv., iv. pl. 1, fig. 6, *a. b.*

112. S. SANGUINICOLLIS, *Say.* Bost. Journ. Nat. Hist., i. 194.

Olivier has a North American species under the same name, (pl. 74, fig. 7,) which is probably identical with the *collaris* of Forster, Cent. i. 46, Lin. Gmel., p. 1881, No. 24, and with *cruentatus*, Dej. Cat.

NECYDALIS, *Lin.* Serv., Ann. Ent., ii. 543. R. A., pl. 66, *bis.* fig. 3.

113. N. AMERICANUS.

Rufo-testaceous; head, antennæ, (base and tip tinged with rufous,) thorax, scutel, and abdomen above, black: elytra punctate, more coarsely towards the margin; reddish-brown, with a pale-yellowish spot at tip.

10 lines long. Inhabits Pennsylvania. Molorchus americanus, *Dej.* Cat.

114. N. MELLITUS, *Say.* (Molorchus.) Boston Journ., i. 194. Harris, Hartf. Tr., p. 89. Molorchus cylindricus, *Dej.*

MOLORCHUS, *Fabr.* Mulsant, 107.

115. M. BIMACULATUS, *Say.* Journ. Acad., iii. 428. M. affinis, *Le C.* Ann. Lyc. N. Y., i. pl. 11, fig. 12.

Varies considerably in size. Inhabits from Massachusetts to Alabama. Found in the blossoms of Cornus florida, in April and May, in Pennsylvania.

M. CORNI. Black; prothorax rufous, punctured, a small polished tubercle each side of the dorsal line before the middle, and a longitudinal one behind, forming an equilateral triangle with them; elytra punctured; antennæ about as long as the body. Three lines long.

Molorchus Corni, *Hentz*, MS. Boston Coll., No. 782. M. ruficollis? *Dej.* Cat.—Cuba. Inhabits Carolina in March—May, upon the flowers of cornus.

The insect described under the name of Molorchus marginalis, by Say, in Long's Expedition, ii. 292, is a Malthinus.

LAMIADÆ.

MONELERMA, *Say.* Journ. Acad., iii. 403.

116. M. ANNULATA, *Say.* Journ. Acad., iii. 404. Inhabits Missouri Territory.

ACANTHODERES, *Serv.* Mulsant, 143.

117. A. QUADRIGIBBUS, *Say.* Bost. Journ., i. 195.

Inhabits near New Orleans, Say: Carolina in May and June, Hentz: Pennsylvania, Dr. Melsheimer. Boston Coll., No. 1039. A. distinctus, *Dejean.*

118. A. TRIANGULIFER.

Dull reddish-brown, elytra with a large, irregular triangle behind the middle, running from the outer margin to near the suture; and a small one near the apex. 6‴ long; 2⅓ wide. Inhabits Alabama.

Robust, antennæ annulate with cinereous on the basal half of the articulations: sides of the prothorax cinereous, with a black spot in front of the spine; a black spot on each side above: scutel and adjoining portion of the elytra black: elytra slightly emarginate, covered with small impressed punctures: feet annulate, with cinereous; segments of the venter margined with black.

ÆGOMORPHUS, *Dejean* Cat., p. 363.

Distinguished from ACANTHODERES by having the antennæ slightly fringed beneath; and an additional spinose tubercle on each side of the prothorax above.

119. Æ. DECIPIENS.

Cinereous brown, punctured; front plane, whitish; elytra with three obscure, oblique, subparallel bands, middle one undulated. 6‴ long; 2¼ wide. Cab. Le Conte.

Front and labrum covered with short, whitish hair, sprinkled with a few minute, black dots; frontal line impressed; vertex with a slight, dark elevation between the medial line and eyes; mandibles black; eyes reddish-brown, with a brassy reflexion; antennæ reddish-brown, annulate with gray: prothorax cinereous, with numerous dark, dilated, impressed punctures; a conspicuous black, smooth tubercle each side of the dorsal line; lateral spines direct, punctured posteriorly; dorsal line marked by the lighter colour of the hair, which is continued upon the scutel, and bounded upon the latter and posterior extremity of the former with a lateral black line: elytra with an indistinct, oblique, black band from near the base of the suture, towards the humeral angle; an undulated, W-shaped, post-medial one; and a small one near the apex, bounded by a black dot exteriorly; suture cinereous, marked posteriorly with a row of about eight black dots; external margin similarly marked; apex truncate, scarcely emarginate separately; external side slightly produced: feet reddish-brown; femora clavate, covered with cinereous hair; tibiæ annulate with the same material: inferior parts testaceous, slightly clothed with cinereous.

The ground colour, where it can be distinguished, seems to be uniformly testaceous.

120. Æ. . . . . A second species, too imperfect to admit of description.

*ASTYNOMUS.

An uncharacterized genus of Dejean, including Ædilis, but which I restrict to the species here cited; assuming the remarkable enlargement at the extremity of the third articulation of the antennæ in the male as the generic characteristic.

121. A. NODOSUS, *Fabr.* Syst. El. ii. 289. Oliv., pl. 14, fig. 103. Encyc., v. 291.

This rare species has been found in Pennsylvania and Maryland.

AMNISCUS, *Dejean.*

122. A. PERPLEXUS.

Dull, obscure brown; pronotum with two tubercles; elytra with an indistinct, submarginal costa, and rather regular series of impressed punctures. $5\frac{1}{2}'''$ long; (elytra $4\frac{1}{4}$,) $2\frac{1}{4}$ wide.

A. perplexus, *Dej.* Cab. Le Conte. Front convex, medial line impressed, particularly between the antennæ; labrum fulvous, mandibles shining black; antennæ obscurely annulate: prothorax with small, impressed punctures, largest posteriorly, and wanting upon the obtuse lateral tubercle, pleura margined anteriorly and posteriorly with large ones, of which there is but a single row posteriorly; a small, longitudinal tubercle along the dorsal line posteriorly, and a small, circular, shining one each side of it anteriorly: scutel longitudinally impressed: elytra entire at tip, an indistinct, cinereous spot behind the middle, and at the basal angle, and a row of black points along the suture posteriorly: feet and under parts with numerous small spots: elytra cinereous, hairy, mottled with dark-brown.

123. A. COLLARIS.

Dull reddish-brown, with darker spots; five tubercles arranged around the posterior margin of the prothorax. $4\frac{3}{4}'''$ long; (elytra $3\frac{1}{2}$,) 2 wide.

Front uniformly dull cinereous; medial line strongly impressed, eyes dark-brown, with a golden reflexion; antennæ and feet annulate: prothorax thickly punctured, a large tubercle in the middle posteriorly, and another each side between it and the lateral tubercle; elytra punctate, basal angles glabrous black, whence a dark-brown, irregular band extends backwards to the middle, and then narrows towards the suture; one or two black spots near the suture posteriorly; suture with a row of dark points; apex sub-entire: metasternum with yellowish hair, indistinctly dotted with brown: ground-colour dull testaceous.

124. A. ALBESCENS.

Grayish-white, antennæ spotted and annulate with brown; elytra scabrous, with numerous elevations, posterior third and epipleura brown. $10\frac{1}{2}$ mm. long; (elytra 8) 4 wide. Boston Collection, No. 545?

Ground-colour blackish-brown, covered with close, short hair: head concave between the antennæ, medial line wanting; eyes and mandibles black; mouth yellowish-brown; antennæ with a dark-brown annulation at the apex of every articulation, confluent with a paler and more indistinct one at the base of each succeeding one; third and fourth articulation thickly maculate with brown, five or six terminal articulations without spots: pronotum with five tubercles around the posterior margin, central one in the dorsal line, conspicuous and polished, lateral ones clothed like the general surface; an obtuse elevation each side anteriorly, medial line but slightly marked: elytra with a sutural and three lateral costæ, marked with elevated points; a small brown macula near the suture behind the middle; suture with a row of black points; epipleura with a dark-brown spot extending to the middle of the elytra, where it rises in a point, forming a triangle; apex dark-brown, slightly marked with cinereous, somewhat truncate within; tarsi blackish-brown, extremity of the tibiæ and an annulation near the base of the same colour: under parts with a tinge of reddish, slightly clothed with hair; sternum more thickly clothed, and irrorate with brown.

VAR. A. asperatus, *Dej.* Elytra, with the posterior black spot wanting, and having a short, curved ridge at the base, extending from the scutel to the suture; scutel brown. $3\frac{1}{4}$ lines long.

125. A. MARGINELLUS.

Robust, cinereous brown, elytra with a whitish band posteriorly, bounded with a black line anteriorly and posteriorly; apical third brown. 9 mm. long; (elytra 7,) 4 wide.

A. marginellus, *Dej.* Cat.—Cab. Le Conte. Front mottled with cinereous and brown, impressed between the antennæ; a narrow frontal line continued over the vertex, where it has a short, black band on each side; eyes, mandibles, and maxillary palpi black, apex of the latter yellowish; labium and palpi yellowish; a glabrous, black spot behind the eye; antennæ maculate and annulate, as in the preceding species, the scapus being maculate in addition: pronotum unequal, medial line elevated, glabrous, widest posteriorly, where it forms a tubercle; lateral tubercle posterior, obtuse, projecting; another intermediate between it and that of the dorsal line, an indistinct, cordate elevation anteriorly, and converging to the posterior dorsal tubercle: scutel and adjoining portion of the elytra blackish: elytra slightly truncate at tip, rough, with numerous elevations, cinereous brown, with a greenish tinge, interspersed with black tufts, which form a sub-basal and post-medial macula, the latter diverging obliquely backwards from the suture, which is dotted with black, epipleura greenish, irrorate with black, margin with a row of black dots, a black, submarginal band from the shoulder to the middle, indistinctly continued across the prothorax: feet and beneath with short, prostrate hair, spotted with brown; tibiæ bi-annulate with blackish, tarsi blackish.

126. A. ACULIFERA, *Say.* (Lamia.) Journ. Acad. Nat. Sci., iii. 329.

Thorax unequal; elytra unequal, with numerous elevated points, aculeate, with a white band behind; *tip entire.* Four lines long.

I have not met with a specimen which could be determinately referred to this species.

127. A.? CRYPTUS, *Say.* (Lamia.) New species of insects, found by Joseph Barabno, in Louisiana.

Clothed with dark, ferruginous, prostrate hair. $6\frac{3}{4}$ lines long.

128. A. VARIEGATUS.

Brown, spotted with black, elytra with two approximate costæ united posteriorly, with an intermediate black spot behind the middle, bounded posteriorly by an elongate, cinereous spot. $4\frac{1}{4}'''$ long; (elytra $3\frac{1}{4}$,) $1\frac{3}{4}$ wide.

Ground-colour, reddish-brown; mouth pale, glossy, yellowish-brown; front slightly convex, covered with yellowish, prostrate hair, sprinkled with black; medial line a dark streak, indented between the antennæ, and crossed by a transverse, indented line at the posterior base of the antennæ, a glabrous point at the junction; antennæ brown, scapus annulate in the middle, with cinereous, remaining articulations, with the basal third, of the same colour: pronotum with minute, black punctures, a small, central black spot, and another on each side anteriorly, forming a triangle; scutel black: elytra truncate at tip, surface with numerous, impressed punctures, each with two longitudinal costæ, which unite near the apex, a cinereous spot lying in the commissure; costæ, suture, and external margin marked with a row of black dots; beneath reddish-brown, scarcely hairy; feet annulate.

VAR. A. *trifasciatus.* Mouth not yellowish; elytra with three, irregular, transverse, dark-brown bands, the first sub-basal, extending outwards and forwards from the suture towards the shoulder, the second medial, and the third in the line of the posterior black spot. Inhabits Alabama.

VAR. A. *obscurus.* Very dark-brown, with three indistinct, black bands; beneath blackish-brown.

129. A. COMMIXTUS.

Brown, with a few yellowish spots and numerous black tufts; pronotum finely and irregularly punctured; elytra bi-costate, and thickly covered with large dilated, impressed punctures. $9\frac{1}{2}$ mm. long; (elytra 7,) 4 wide. Inhabits Washington City.

Front covered with olivaceous hair, spotted with brown; labrum and clypeus yellowish-brown over the vertex; a large brown spot at the inner base of the antennæ, and another on the vertex; antennæ cinereous, spotted and annulated with brown; pronotum with an obsolete, black tubercle on each side anteriorly; scutel black, with a few yellowish hairs; elytra with two costæ united towards the apex, inner one with a conspicuous, lengthened,

black tuft at the base, a smaller one behind the middle, followed by another posterior one, these, with two corresponding ones, forming a common quadrangle; a yellowish spot near the base and exterior margin; suture with a row of small tufts; exterior margin spotted with yellowish; apex truncate: femora and under parts spotted with brown, tibiæ annulate. Colour and general appearance of the preceding *variety*.

I have a small, imperfect specimen from Massachusetts, (Boston Collection, No. 537,) and another from Carolina, (ib. No. 1040,) which appear to be the same species, although not more than $3\frac{1}{2}$ lines long. Another individual, 3 lines long, belongs to the collection of Dr. Le Conte.

130. A. INTERRUPTUS.

Brown, punctured, prothorax surrounded posteriorly with five tubercles, elytra truncate, with two costæ, numerous glabrous, and four indistinct, cinereous spots. $3\frac{3}{4}'''$ long; (elytra $2\frac{3}{4}$,) $1\frac{1}{2}$ wide. Inhabits Pennsylvania.

Cerambyx interruptus, Mels. Cat., No. 742. Front and antennæ spotted, the latter annulated with brown; frontal line impressed throughout, a transverse line between the eyes and antennæ; margin of the labrum yellow, palpi rufous: elytra reddish-brown, slightly hairy, with glabrous portions; an obsolete, cinereous spot at the base, another at the outer margin behind the middle, a third posterior to this at the suture, and a fourth at the junction of the costæ; outer margin with a brown macula near the shoulder; epipleura cinereous, margined above and below with a row of brown spots: feet and beneath cinereous hairy, spotted with brown; tibiæ annulate.

131. A. FASCICULARIS, *Harris.* (Mesosa.) Tr. Nat. Hist. Soc., Hartford, i. 88.
4 lines long.

132. A. STICTICUS, *Dejean.* 8 mm. long; (elytra 6,) 3 wide.

This is probably a large variety (or perhaps the female,) of A. MACULA, *Say*, in which the cinereous spot on the elytra extends to the suture. It appears to be noticed by Say, when he describes the gray spot of the elytra as "rarely reaching the suture."

133. A. MACULA, *Say.* (Lamia.) Journ. Acad. Nat. Sci., v. 268. Mels. Cat., No. 735. A. hebes, *Dej.* Inhabits Pennsylvania, in June—August.

134. A. ALPHA, *Say.* (Lamia.) Journ. Acad. N. Sc., v. 270. Mels. Cat., No. 738. Graphisurus pusillus, *Kirby*, N. Z., 169. Pennsylvania. A. cinereus, *Dej.*, appears to be a small variety, with rather rougher elytra.

VAR. A. *divergens.* Dull-brown, elytra with blackish velvety points, and a band behind the middle, running backwards and outwards from the suture. 2 lines long. Inhabits Pennsylvania.

Head convex, with a deep impression between the antennæ; fifth, sixth, and seventh articulations of the antennæ pale-yellowish, and with the third and fourth tipped with black: pronotum with two diverging, velvety lines: elytra minutely punctured, having blackish, velvety points, and an oblique band behind the middle, in front of which the surface is slightly cinereous, with short hairs; inner extremity truncate; sternum and feet dull-brown, obscurely cinereous; abdomen darker, polished.

135. A. LATERALIS.

Uniform reddish-brown, subglabrous; epipleura with a black band. 6 mm. long; (elytra $4\frac{1}{2}$) 2 wide. Inhabits Pennsylvania.

Front convex, covered with dull-grayish hair, deeply sulcate between the antennæ; eyes black, prominent; antennæ with the articulations tipped with blackish: prothorax finely punctured, and having a prominent lateral tubercle, behind which it is suddenly reduced; an obsolete tubercle each side of the middle, anteriorly: elytra with impressed punctures, sparsely hairy, with a black band along the epipleura from the base to beyond the middle; apex truncate within: sternum slightly hairy.

136. A. PUNCTATUS.

Robust, brown, densely clothed with short hair, elytra with four rows of black points. 5 mm. long; (elytra 4.) 2 wide.

Frontal line impressed, entire; antennæ with the apex of the articulations blackish: prothorax finely punctured, a prominent lateral tubercle, behind which the diameter is suddenly reduced: elytra truncate, with two or three indistinct costæ, bearing rows of black points; an obsolete cinereous spot behind the middle: femora spotted; tarsi and adjoining portion of the tibiæ blackish: sternum yellowish hairy, with brown spots: venter blackish, with very little hair.

137. A. VICINUS.

Brown, densely clothed; pronotum with three tubercles arranged in a triangle; elytra truncate, with three costæ bearing black points, a black macula upon the inner one behind the middle, epipleura with a black band.

$4\frac{3}{4}$ mm. long; (elytra $3\frac{1}{2}$,) $1\frac{3}{4}$ wide. A. vicinus, *Dej.* Cab. Le Conte.

Head sulcate between the antennæ; antennæ dull yellowish, feebly spotted with brown, and annulate with blackish at the apex of the articulations: prothorax armed laterally, a tubercle in the dorsal line posteriorly, and another each side anteriorly: elytra minutely punctate, a few black points along the costæ, and a black macula near the suture behind the middle, bounded exteriorly by an obsolete, cinereous spot.

This and the two preceding species are nearly allied.

138. A. FACETUS, *Say.* (Lamia.) Journ. Acad. Nat. Sc., v. 271. Mels. Cat., No. 739, 741, 743. A. pumilus, *Dej.* Inhabits Pennsylvania, appearing in June.

139. A. PAGANUS, *Dej.* Cat.

140. A. CONFINIS, *Dej.* Cat.

141. A. GLAUCINUS, *Dej.* Cat.

*HYPERPLATYS (< Leiopus.)

General characters of Leiopus, *elytra* plane above, apex separately emarginate; scutel triangular, apex rounded.

Agrees with Leiopus in the re-curved spine upon the prothorax, in having incrassated femora, and in several minor characters, but the entire form is depressed.

142. H. MACULATA.

Pale reddish-brown, irregularly spotted with dark-brown, two large spots upon the pronotum, and two upon the elytra behind the middle.

$2\frac{1}{4}'''$ long. Inhabits Pennsylvania. Cerambyx punctatus and maculatus, *Mels.* Cat., No. 734. Leiopus tigrinus? *Dej.* Catalogue.

VAR. H. *Nigrellus.* Black; cinereous above, spots black.

143. H. ASPERSA, *Say.* (Lamia.) Journ. Acad. N. Sc., iii. 330. Leiopus puellus? *Dej.* Boston Collection, No. 543? Inhabits Missouri, Mississippi, and Alabama?

Closely allied to the preceding, but the femora are "reddish-brown" or orange, and the spots are more regular in disposition and size.

144. H. FEMORALIS.

Dull black, minutely scabrous; apex of the elytra produced in a spine exteriorly; basal half of the femora orange yellow. $5\frac{1}{2}$ mm. long; 2 wide. Alcidion femorale, *Dej.* Catalogue.

Characterized from an imperfect individual in Dr. Le Conte's cabinet.

LEIOPUS, *Serv.* Ann. Ent. Fr., iv. 86. Muls., 149.

145. L. SYMMETRICUS.

Cinereous hairy above, with oblong, brown maculæ; beneath testaceous. $3\frac{1}{2}'''$ long; (elytra $2\frac{1}{2}$,) 1 wide. Cerambyx symetrus, *Knoch.* Mels. Cat., No. 736. Leiopus gilvicornis, *Dej.* Catalogue.

Front slightly hairy, medial line impressed, mouth testaceous: pronotum cinereous, a brown band each side of the middle; elytra separately rounded at tip; pale cinereous; outer margin brown; a small, oval, brown spot at the base; a lengthened one in the middle, very near the suture, and a minute one at the apex: feet dull reddish-brown, extremity of the tibiæ blackish.

VAR. L. *confluens.* Every portion paler, allowing less contrast in the colours of the elytra, which have but little cinereous, the spots being confluent with the brown of the margin, leaving a large, common, cinereous spot about the middle, and a smaller one near the apex.

146. L.? SPINOSUS, *Say.* (Lamia.) Journ. Acad. N. Sc., v. 271. Mels. Cat., No. 770.

EXOCENTRUS, *Muls.*, 152, pl. 3, fig. 3.

147. E. DASYCERUS, *Say.* (Lamia.) Journ. Acad. N. Sc., v. 270. E. humilis, *Dej.*

Inhabits Massachusetts, Pennsylvania, and Carolina, appearing in June. Boston Collection, No. 552.

148. E. EXIGUUS, *Dej.* Cat. $1\frac{1}{2}'''$ long.

149. E. OBSCURUS.

Dark-brown, elytra with dilated, impressed punctures, and two costæ, exclusive of a sutural one.

$3\frac{3}{4}'''$ long; (elytra $2\frac{1}{2}$,) $1\frac{1}{3}$ wide. Pennsylvania. Cabinet of the Reverend D. Ziegler.

Frontal line impressed throughout; a tubercle each side of it on the vertex; antennæ dark testaceous, indistinctly annulate; trophi rufous: elytra scarcely truncate, two small black spots side by side, near the posterior extremity: metasternum cinereous hairy, spotted with blackish: feet dark-brownish rufous.

This species is at first view distinguished from *dasycerus*, by the superior size and darker colour.

POGONOCHERUS, *Latr.* Serv. Muls., 155, pl. iii. fig. 4.

150. P. MIXTUS.

Head and thorax blackish-brown, sparsely covered with erect hairs; elytra brown, varied with yellowish cinereous. $2\frac{1}{2}'''$ long. Inhabits Pennsylvania. Cab. Melsheimer.

Head sparsely hairy, black, with an indistinct, yellowish spot before the eyes; frontal line impressed; antennæ testaceous, with the tip of the articulations blackish; scutel black: elytra hispid; base, middle, and apex brown: extreme tip and an oblique band before the middle running forwards and outwards, yellowish, with a few brown dots; extreme base testaceous: feet brown, varied with testaceous.

The thoracic tubercles are rather prominent.

151. P. VESTITUS, *Say.* (Saperda.) Journ. Acad. N. Sc., v. 273. Inhabits Alabama.

This is a very different insect from the Saperda vestita, *Say.* Long's Expedition, ii. 290.

DESMIPHORA, *Serv.*

152. D. TOMENTOSA.

Rufo-testaceous, head and prothorax reddish-brown; every part covered with erect hairs.

3''' long; (elytra $2\frac{1}{4}$,) 1 wide. D. tomentosa, *Dej.* Cat. Cab. Le Conte.

Prothorax with confluent, impressed punctures, and a prominent lateral spine behind the middle: elytra with piliferous punctures, and a few indistinct tufts of yellowish hair; apex entire.

MONOHAMMUS, *Latr.* Serv., Ann. Ent., iv. 91.

153. M. TITILLATOR, *Fabr.*, ii. 295. Oliv., Ins., pl. 15, fig. 109. Drury, —. Harris, 88.

154. M. DENTATOR, *Fabr.*, ii. 294, carolinensis, *Oliv.*, pl. 12, fig. 88.

155. M. BIFIDATOR, *Fabr.*, ii. 286.

156. M. SCUTELLATUS, *Say.* (Cerambyx.) Long's Expedition, ii. 289. M. Faber, *Dej.* M. resutor, *Kirby*, N. Z., 167.

157. M. SUTOR, *Lin.* Harris's Catalogue.

Perhaps Dr. Harris's insect is the preceding species, which is the analogue of M. scutellatus.

158. M. MACULOSUS.

Blackish-brown, thoracic spines and scutel white; elytra cinereous and brown intermixed, the latter in raised, tufted patches, apex armed at the suture; sternum and tip of the venter reddish.

9‴ long; (elytra 7,) 3 wide. M. maculosus, *Dej.* Cab. Le Conte.

Closely allied to M. scutellatus, but is less shining, and scarcely brassy, and the white of the scutel is less pure. The essential character is the white upon and around the lateral armature.

159. M. PULVERULENTUS.

Ground colour brown, entirely covered with short, prostrate, whitish hair, indistinctly clouded with pale-brown upon the elytra. $8\frac{1}{2}$‴ long; (elytra $6\frac{1}{2}$,) $2\frac{1}{2}$ wide. Cab. Le Conte.

General surface covered with small, impressed, brown punctures: mandibles black; labrum dotted with brown, and fringed with fulvous hair; front minutely spotted with brown between the eyes and antennæ; frontal line entire; eyes black; scapus brown, dotted; prothorax equal, lateral spines slender; scutel whitish: base of the elytra brownish, an indistinct, irregular band of the same colour behind the middle, tip unarmed; medial femora and tibiæ with a small, glabrous, brown spot about the middle of the posterior side.

160. M. TOMENTOSUS, *Ziegler.* Proceed. Acad. N. Sc., ii. 47. M. confusor? *Kirby*, N. Z., 168.

Dull cinereous with a tinge of reddish; elytra with an irregular, transverse, dark-brown band near the base, and another behind the middle; base shagrined. 12‴ long; (elytra $8\frac{1}{4}$,) 4 wide. Pennsylvania.

Head dark-brown, with a reddish tinge, sparsely covered with prostrate, cinereous hair; an impressed line above; labrum blackish, hairy, margin piceous; clypeus, testaceous with reddish hair; eyes dark reddish-brown; antennæ concolorous with the head, outer articulations paler, except at the tips; pronotum transverse, cinereous, with a medial, glabrous, brown space, and two indistinct ones each side; lateral spine large, direct; scutel cinereous, impressed glabrous along the middle: elytra separately slightly rounded at tip, basal angles prominent, base square, finely shagrined; surface densely covered with short, prostrate, cinereous hair, with a confluent series of blotches, forming an irregular, transverse band near the base, and another behind the middle: under parts reddish, sparsely covered with cinereous hair; feet dull brown cinereous.

161. M. TESSELATUS.

Ground colour brown; above, sparsely covered with yellowish-brown hair, and several irregular spots of the same material; beneath, densely clothed with short, prostrate, fulvous hair. 12‴ long; (elytra 9,) 4 wide.

M. tesselatus, *Dej.* Cat. Cab. Le Conte. M. Marmorator? *Kirby*, Northern Zoology, 169.

Trophi dark reddish-brown, mandibles black, frontal line entire; eyes black; head above, and pronotum, scabrous; scutel covered with fulvous hair: elytra mutic, minutely shagrined at base, covered with small, impressed, punctures, and scattered dots of yellowish hair, of which there is an irregular row near the suture, a more regular one between two indistinct costæ, and a few exterior to these, the remainder lying along the external margin and at the apex.

162. M. PULCHER.

Ochraceous with a dense covering of short hair; basal articulations of the antennæ, base of the elytra, and a wide, transverse band behind the middle, brown. 10‴ long; 3 wide. Inhabits Pennsylvania.

Lamia pulchra, *Mels.* Catalogue, No. 753. Monohammus carpentarius, *Dej.* Cat., p. 367.

Frontal line impressed, entire; region of the mouth testaceous; mandibles and eyes black; disk of the labrum blackish; antennæ ochraceous, invested with fine hair, and having a row of scattered hairs beneath; scapus brown, with scattered hairs, remaining articulations with the tips, slightly brown; prothorax sub-equal: scutel conspicuous, its colour being paler than that of the elytra: elytra truncate at tip, shagrined at base, which is brown, gradually passing into ochraceous at the posterior margin; another band commences behind the middle in an irregular but definite line, and passes into the ochraceous of the apex: inferior parts concolorous: ground testaceous.

This handsome insect is rare in collections. I have seen it only in Dr. Melsheimer's, and in that of the Academy of Natural Sciences.

"LAMIA, *Fabr.*"

The Reverend F. W. Hope (Charlesworth's Mag., N. H., iii. 251,) has restricted this generic name to a group named BATOCERA, by Count Dejean, none of the members of which have been found here. It is quoted in this place merely as a depository for such species as cannot be referred to their proper station without an examination of the individuals themselves.

L. BIFIDATOR, *Fabr.*, ii. 286. "Thorace spinoso tuberculatoque cinereo, margine lineolisque atris, elytris cinereis, maculis oblongis atris." Astynomus nodosus, *F.* ♀

L. MIXTA, *Fabr.*, ii. 290. "Thorace spinoso, cinereo fuscoque variegata, antennis longis." Ent. Syst. Supp., 144, 46.

L. OBSCURA, *Fabr.*, ii. 294. "Thorace spinoso, fusca, elytris striatis, apice pallidis, antennis longis."

PLECTRODERA, *Dejean.*

164. P. SCALATOR, *Fabr.*, ii. 295. Oliv., pl. 67, fig. 172.

"Thorace acute spinoso, atra, elytris strigis numerosis interruptis albis, antennis mediocribus,"—belli, Le Conte. (Lamia.)

Mr. Le Conte's specimen was taken near the Rocky mountains.

ONCIDERES, *Serv.*

165. O. CINGULATUS, *Say.* Journ. Acad. Nat. Sci., v. 272. Knoch, in Mels. Cat., 775. O. rubiginosus? *Dej.*

The sexes differ only in the greater length of the antennæ in the male. The scutel is sometimes fulvous. A specimen in Mr. Le Conte's collection, named O. rubiginosus, *Dej.*, has the fulvous spots a little larger than they usually are, and the pronotum is whitish.

Appears in Pennsylvania during the last two weeks in August, and first week in September, upon Carya alba, feeding upon the bark of the small branches. The ova are a line long and half a line in diameter, and are deposited in excavations made for the purpose in the small branches of the tree just mentioned. The female then proceeds to gnaw a groove of a line in width, and nearly as much in depth, around the limb, which, in a short time, dies, and the larva feeds upon the dead wood. The diameter of the branches thus cut is from three to five lines, and it sometimes happens that the upright

stems of small trees are cut in a similar manner, and were the insect abundant, much damage would be done to valuable young forests of a material extensively used for hooping casks. Guilding (Lin. Tr., vol. xiii. pl. 30,) gives a figure of "Lamia amputator" in the act of cutting off a branch.

PTYCHODES, *Chevr.*

Body oblong fusiform, tapering forwards and backwards from the base of the elytra: head long and narrow, contracted forwards; antennæ approximate, filiform, two and a half times the entire length, fifth articulation reaching to the end of the elytra in the male; eleventh longest, ($5\frac{1}{2}'''$,) the third being next in length, ($4\frac{1}{2}'''$,) the fourth to the tenth being about half the length of these: *eyes* divided into two upon each side, the inferior pair large and nearly circular, and the upper ones contracted to a narrow line; palpi slender, ultimate articulation fusiform: prothorax narrowed forwards: elytra tapering rapidly, and ending in a sutural *spine: feet* long and slender, posterior pair shortest, femora simple, anterior tibiæ curved, *medial* pair with a notch near the extremity upon the outside.

166. P. VITTATUS, *Fabr.*, (Saperda) ii. 322.

Pale-brown, with fulvous dots, a broad, lateral, and common, sutural white vitta. 10‴ long; $2\frac{3}{4}$ wide. Drury's Illustrations, i. pl. 41, fig. 1. Inhabits Louisiana.

Head deeply impressed between the antennæ, eyes dark reddish-brown, antennæ scabrous at base, a white lateral vitta extending from the base of the antennæ backwards along the head, propleura, and epipleura: pronotum transversely rugulose, with a white, dorsal vitta, abbreviated before: elytra with a sutural spine at tip; slightly shagrined and punctured at base, with about two longitudinal rows of fulvous spots, and having a broad marginal vitta with its inner edge, and a common, sutural one with its outer margins scalloped: feet and under parts cinereous, except a white spot upon the lateral margin, above the medial—and another above the posterior feet.

TETRAOPES, *Dalman.*

167. T. TETROPHTHALMA, *Forster*, tornator, *Fabr.*, ii. 301. Am. Orn., ii. pl. 11.

Occurs from Massachusetts to Carolina, on Asclepias syriaca. Appears in Pennsylvania in June and July. Common.

168. T. CANTERIATOR, *Drapiez.* Ann. Gen. des Sc., phys. ii. 47, pl. 16, fig. 6,—arator, *Germar*, Sp. nov., 486,—cordifer, *Dej.*

Massachusetts to Alabama, on Asclepias. Rare in Pennsylvania. M. Drapiez' figure does not represent the usual characters of the species. All the specimens I have seen have the medial elytral spots confluent, forming a cordate spot, of which the apex extends backwards and unites with the apical spot, which is also common.

169. T. 5-MACULATA, *Le Conte.*

Rufous; antennæ, scutel, feet, and inferior parts black; four black spots arranged in a quadrangle upon the pronotum, one upon the basal, external angle of the elytra, and another towards the outer margin behind the middle; apex blackish. $4\frac{1}{2}'''$ long. Inhabits Sault Ste. Marie. Cab. Le Conte.

HEBESTOLA, *Dejean.*

170. H. NEBULOSA.

Uniform reddish-brown, with a thin clothing of short, prostrate hair; frontal line slightly marked; pronotum with confluent, impressed punctures, a dilated, abbreviated, glabrous sulcus in the dorsal line; elytra with small, dilated punctures, basal angles glabrous.

$5\frac{1}{2}'''$ long; (elytra 4,) $1\frac{1}{2}$ wide. H. nebulosa, *Dej.* Cab. Le Conte.

*HETŒMIS.

Body slender, head produced, slightly wider than the prothorax; eyes prominent; antennæ slender setaceous, double the length of the body, third articulation longest, and double the length of the fourth, fifth slightly longer than the fourth, subsequent ones gradually longer; palpi slender, pointed: prothorax narrower than the head and elytra, cylindrical, longer than wide, a transverse groove anteriorly and posteriorly: elytra square at base, convex above, deflexed upon the sides, subparallel, narrowed and produced posteriorly in a spinose apex: feet moderate, anterior pair longest, femora robust.

171. H. JUGLANDIS.

Body entirely invested with short, prostrate, olivaceous hair; antennæ smooth, rufous; pronotum with a black, bi-abbreviated dorsal line. $5\frac{1}{2}'''$ long; $1\frac{1}{4}$ wide. Inhabits Pennsylvania and Alabama.

Saperda juglandis, *Knoch.* Mels. Cat., 769. Hetœmis cinerascens, *Dej.* Cat., p. 374.

Head with the frontal line impressed, a black, longitudinal, triangular line above, and another behind the eyes; trophi and antennæ dark rufous; eyes dark-brown, iridescent in a particular light: elytra thickly and finely punctured: feet black.

This species has been found, by Mr. Hentz, on the leaves of Morus rubra. Say's description of Saperda trilineata agrees very nearly with this insect; but the two are quite distinct.

LYPSIMENA, *Dejean* Cat., 374.

172. L. FUSCATA, *Dej.*

A drawing in Captain Le Conte's collection represents this insect as three lines long, with a whitish line along the middle of each elytron, from the centre to the apex.

DORCASCHEMA, *Dej.* Cat., p. 375.

Distinguished from Hetœmis by having the apex of the elytra conjointly rounded.

173. D. ALTERNATA, *Say.* (Saperda.) Journ. Acad. N. Sc., iii. 405. S. maculata, *Mels.* Cat., No. 778. D. leptocera, *Dej.* A specimen found in Pennsylvania.

174. D. NIGRA, *Say.* (Saperda.) Journ. Acad. Nat. Sc., v. 272. Mels. Catalogue, 777. D. nigricans, *Dej.* Inhabits Pennsylvania.

HIPPOPSIS, *Serville.*

175. H. LEMNISCATA, *Fabr.*, ii. 330—lineolata, *Dej.* Inhabits Pennsylvania, appearing in July, and found upon grass, overhanging water courses. Rare.

ANÆREA, *Mulsant*, 184.

176. A. CALCARATA, *Say*. (Saperda.) Journ. Acad., iii. 408. Harris, 88.

177. A. MUTICA, *Say*. Ib., 409. Western States. Cab. Le Conte.

178. A. OBLIQUA, *Say*. Ib., v. 274. Found in Pennsylvania.

COMPSIDEA, *Mulsant*, 183.

179. C. TRIDENTATA, *Oliv.*, iv., pl. 68, fig. 48. Inhabits Pennsylvania.

VAR. C. *dubiosa*. Dark testaceous, spot on the pronotum and four common, sutural cordate spots replaced by shining facets; antennæ, tibiæ and tarsi black. 5‴ long.

180. C. LATERALIS, *Fabr.*, ii. 323. Oliv., iv., pl. 68, fig. 41. Pennsylvania.

181. C.? PUNCTICOLLIS, *Say*. Journ. Acad. N. Sc., iii. 406.

182. C.? TRILINEATA, *Say*. Ib., v. 273. Mels. Cat., 771—cinerea, *Kn.*

SAPERDA, *Fabr.* Mulsant, 185.

183. S. VESTITA, *Say*. Long's Second Exp., ii. 290. S. cervina, *Dej*. Mass., Pa., Mich.

184. S. PULLATA.

Ground colour dull rufous, clothed with short, prostrate, cinereous hair; pronotum with a longitudinal, black spot, elytra truncate. 7‴ long; 2 wide. Inhabits Alabama?

Frontal line impressed, destitute of hair, and continued over the apex; antennæ dark rufous; labrum and clypeus covered with fulvous hair; mandibles black: prothorax narrowest behind; dorsal line impressed, and having a longitudinal, bi-abbreviated black spot, which is widest posteriorly: elytra truncate at the inner tip, and having a slight sutural stria posteriorly.

185. S. CANDIDA, *Fabr.*, ii. 319—bivittata, *Say*. Journ. Acad. N. Sci., iii. 409. Harris's Injurious Insects, p. 89.

Fabricius did not know the native country of the specimen he described, but as he refers to a collection which was rich in North American species, I have no doubt of the correctness of this determination. It appears, from Dr. Harris's account, to be common in New England, where it is destructive to apple orchards. Dr. Melsheimer has a specimen, taken in Pennsylvania, which is the *bifasciata* of his father's catalogue, No. 783.

186. S. OCULATICOLLIS, *Say*. Journ. Acad. N. Sc., iii. 406.

187. S. INORNATA, *Say*. Ib., 407.

188. S. PERGRATA, *Say*. Ib.

POLYOPSIA, *Muls.*, 190.

189. S. ANALIS.

Nigropiceous, shining, sparsely covered with pale, fulvous hair; apex of the elytra with a large, circular, common, holosericeous macula. 5½‴ long; 1¾ wide. Inhabits Pennsylvania.

Head, prothorax, pleura, and elytra with impressed, dilated punctures: front convex, eyes black: prothorax widest behind, punctures confluent upon the sides; scutel wide and short: elytra square at base, where the punctures are largest, a little wider than the prothorax, tipped with a large, black, circular spot, which is bounded posteriorly by thickly-set, pale-yellowish hairs: venter shining black, particularly three spots upon each side, which are divested of hair.

The terminal black spot gives the elytra the appearance, on a casual view, of a deep emargination, as in Tomicus.

*ATIMIA.

Body robust, partially clothed with short, prostrate hair; *head small*, nutant, eyes prominent, deeply emarginate, projecting beyond the thorax; antennæ subfiliform, two-thirds the entire length, (♀ ?) first articulation robust, second nearly half the length of the third, *fifth* longest, subsequent ones subdentate, gradually shorter, eleventh fusiform, pointed: prothorax wider than long, sides convex, rapidly narrowed anteriorly: scutel rounded at tip: elytra curved above, narrowing posteriorly, truncate at tip: feet short, weak; femora slightly clavate.

190. A. TRISTIS.

Shining black, maculate with short, prostrate, fulvous hair; feet dull testaceous. 4‴ long; 1⅓ lat.

Inhabits Pennsylvania. Cab. Melsheimer and Le Conte.

Head, except a bare line on the vertex, covered with hair: pronotum with fine impressed punctures, lateral margins densely clothed, middle with a few hairs; scutel clothed; elytra slightly punctured, considerably wider than the prothorax, with the external angles rounded, and extremely narrowed; a sutural row of yellowish dots, the external portions irregularly maculated with the same colour: under parts slightly hairy.

*ATAXIA.

Body somewhat slender; antennæ setaceous, as long as the body, or somewhat shorter, fourth articulation longest: prothorax subcylindrical, length and width equal, sides with a short *spine;* scutel triangular: elytra rounded above, tapering gradually towards the tip, which is truncate: feet slender, thighs slightly clavate.

Resembles the genus UROCALYMMA, *Westw.*, (Arcana Ent., p. 58,) in the armature of the prothorax and the form of the body, but the elytra are not produced. I place it here on account of its great general similarity to SAPERDA.

191. A. SORDIDA.

Pale dull-brown sericeous, upon a black ground. 6‴ long; 1½ wide. Inhabits Alabama,

Head hairy, frontal line inconspicuous; eyes black; antennæ slender, dull brown, hairy beneath, a narrow, white annulation at the base of the articulations: pronotum and elytra with deep, dilated punctures, arranged in striæ from about the middle to near the extremity of the latter, which is truncate: feet with numerous detached, erect hairs.

STENOSTOLA, *Muls.*, 192.

192. S. FUSCIPES, *Say.* Journ. Acad. N. Sc., v. 273.

Black, above, front and beneath cinereous white; femora livid, tibiæ and tarsi black.

4½‴ long; (elytra 3⅓,) one and one fifth wide. Stenostola sulphuripes, *Dej.* Mels. Cat., No. 780.

VAR. *dorsalis.* Dorsal line cinereous.

OBEREA, *Mulsant*, 194.

193. O. RUFICOLLIS, *Turton.* Lin. ii. 316.

Rufous; eyes, antennæ, palpi, tibiæ, tarsi, and wings black; elytra gray, on a black ground. 6—7‴ long. Inhabits Pennsylvania and Alabama.

This is our largest species, and may be distinct from the true *ruficollis.*

194. O. OCELLATA.

Rufous, a black puncture on each side of the pronotum; elytra and eyes black. 6½‴ long; 1½ wide. Inhabits Pennsylvania. Saperda ocellata, *Knoch.* Mels. Cat., No. 772. Oberea bicolor, *Dej.* Catalogue.

Antennæ dull black, or blackish-brown; tibiæ and tarsi discoloured. Closely allied to the preceding.

195. O. MYOPS.

Yellow; antennæ, eyes, a spot upon each side of the pronotum, lateral elytral vittæ, and tarsi, black. 7‴ long.

A drawing in the cabinet of Major Le Conte.

196. O. GRACILIS, *Fabr.*, ii. 354.

Yellow; antennæ, eyes, wings, tarsi, and lateral elytral vittæ, black. 5‴ long.

197. O. AMABILIS.

Yellow; mouth, eyes, a spot upon each side of the pronotum, scutel, suture, and lateral elytral band, black; antennæ annulate; middle and tip of the venter black.

4‴ long. Cab. Le Conte. O. amabilis, *Dejean* Cat.

198. O. TRIPUNCTATA, *Fabr.*, ii. 331—plumbea, *Oliv.* Harris's Injurious Insects, p. 91.

Inhabits Massachusetts, Pennsylvania, and Carolina, appearing in June.

199. O. FLAVIPES.

Black, elytra dull brown, with the region of the scutel and basal margin of the epipleura yellow.

4¾‴ long; ¾ wide. Pennsylvania. Cab. Melsheimer.

Head and eyes black, antennæ dark-brown, palpi pale-yellow: prothorax black, with two black, tubercular spots above: feet pale-yellow.

200. O. PERSPICILLATA.

Grayish-black, prothorax yellow, with two black spots. 3½‴ long. Cab. Le Conte. O. perspicillata, *Dej.* Cat.

Closely allied to *tripunctata*, but the punctures are smaller, and more scattered upon the vertex; and the palpi are black, whilst in *tripunctata* they are dark-brown, with the articulations tipped with yellowish.

201. O. MONOSTIGMA.

Black; head, prothorax, and feet, rufous; a black spot on the middle of the pronotum. 3‴ long; ¾ wide. Pennsylvania. Cab. Melsheimer.

Eyes black, antennæ dark-brown, annulate with yellowish: elytra black, with rather long hairs directed backwards.

PHYTŒCIA, *Mulsant*, p. 199.

202. P. TIBIALIS.

Black; anterior tibiæ and half the femora rufous. 4¼‴ long; (elytra 3,) 1 wide. Pennsylvania. Cab. Melsheimer.

Slender, eyes black, orbits with cinereous hairs: thorax somewhat hairy: elytra gradually tapering, flattened above, obliquely truncate at tip on the inside: medial femora slightly rufous at tip, on the posterior side: beneath slightly cinereous.

203. P. FEMORALIS.

Robust, black, cinereous hairy; femora rufous; elytra convex, separately rounded at tip.

3‴ long; (elytra 2¼,) 1 wide. Cab. Le Conte. P. femoralis, *Dej.* Catalogue.

AMPHIONYCHA, *Dejean.*

204. A. MARGINATA, *Fabr.*, ii. 331.

Robust, black, hirsute, antennæ suddenly reduced in thickness, and the articulations much shortened, from the fifth outwards; mouth rufous, front fulvous; a fulvous band extending from above the eye across the propleura, and along the margin of the elytra to the middle. 4‴ long.

DISTENIA, *Encyc.*

205. D. UNDATA, *Fabr.*, ii. 311. Oliv., pl. 69, fig. 15. Pennsylvania—July.

LEPTURINÆ.

DESMOCERUS, *Dej.* R. an., pl. 69, fig. 1.

206. D. PALLIATUS, *Forster.* Harris, 92—cyaneus, *Fabr.* Mass., Penna., June, July.

The figure in the atlas to the new edition of the *Règne Animal* which is given for the antennæ of this species, was probably figured in error, as it is incorrect.

RHAGIUM, *Fabr.* Mels., 222.

207. R. LINEATUM, *Oliv.*, (Stenocorus) pl. 69, fig. 22. Harris, 93—stripe-necked hargium! *Kirby*, 178.

RHAMNUSIUM, *Latr.* Mels., 220.

208. R.? DECOLORATUM, *Harris*, Injurious Insects, p. 93. Perhaps the next species.

TOXOTUS, *Serv.* Mels., 231.

209. T. RUDIBUS.

Uniform dark-brownish-red, elytra yellowish-brown. 9‴ long; 2 wide. T. rubidus, *Dej.* Cat.

Head large, a prominent tubercle at the inner side of the torulus; antennæ robust; eyes large and prominent: impressions of the pronotum profound: elytra with numerous, dilated, impressed punctures, largest at the base, tip separately rounded.

210. T. PICTUS.

Reddish-brown, dull olivaceo-sericeous; elytra ochraceous, with irregular, longitudinal, brown lines.

7‴ long; 1½ wide. Inhabits Pennsylvania. Rhagium pictum, *Knoch.* Mels. Cat., No. 785.

Head small, eyes not prominent; antennæ slender setaceous: thoracic impressions moderate: elytra with a brown line arising near the base, and extending beyond the middle, slightly approaching the suture; another, interrupted with yellow at two points, extends from the epipleura backwards and inwards to near the extremity, and a third short one lies at the outside extremity of the latter; surface thickly covered with impressed punctures, and invested with fine, sparse, prostrate hairs, tip conjointly rounded.

211. T. TRIVITTATUS, *Say.* Journ. Acad. N. Sc., iii. 422. Inhabits Mississippi. T. vittigera, *Randall.*

VAR. *nigripes.* Outer margin of the elytra yellow, feet black. Inhabits Pennsylvania.—Le Conte.

212. T. ATRATUS.

Dull brownish-black; pectus, posterior femora, fifth and succeeding articulations, margin of the ventral segments, and of the epipleura, rufous.

10‴ long; 2¾ wide. Inhabits Georgia. T. atratus, *Le Conte*, MS.

Allied to the next species. There is a rufous spot beneath the eyes, and the clypeus is of the same colour; frontal line and thoracic impressions profound; elytra obliquely truncate and very slightly emarginate; anterior and medial femora slightly tinged with rufous.

213. T. CYLINDRICOLLIS, *Say.* Journ. Acad. Nat. Sc., iii. 417. Rhagium sericeum, *Knoch.* Mels. Cat., No. 787. Inhabits Pennsylvania.

214. T. DENTIPENNIS.

Rufous; tibiæ, tarsi, and apex of the femora dark-brown or blackish; elytra separately, obliquely emarginate. 6‴ long; 2¼ wide. Inhabits Alabama? T. dentipennis? *Dej.* Catalogue.

Allied to the two preceding in form, and in the deep impressions of the head and pronotum. The elytra are sericeous, and the colour varies from yellowish rufous with a brown base, to brown. Antennæ yellowish rufous, and very robust; as long as the body in the male, and slender and short in the female.

215. T. ÆSCULI.

Uniform pale fulvous, eyes blackish, elytra sericeous, separated at tip, and minutely truncate.

5‴ long; 1½ wide. Carolina, April. Boston Collection, No. 1369.

Distinguished from *dentipennis* by its smaller size, more slender feet and antennæ, uniform colour, simple elytra, and fainter frontal and thoracic impressions.

216. T. VESTITUS, *Klug*.

Black, head and thorax lanate, venter and elytra testaceous, the latter entire. 6‴ long; 1½ wide. Oregon. Cab. Le Conte.

217. T. COARCTATUS.

Black, mixed with rufous; elytra very much contracted behind the middle, and divaricate at tip.

8‴ long; 2 wide. Inhabits Pennsylvania. Rare. T. coarctatus, *Dejean*. Cab. Melsheimer.

Head rufous, scapus and vertex black; frontal line slightly impressed: prothorax subequal, blackish, slightly marked with rufous anteriorly: anterior feet rufous: elytra blackish, basal third brownish rufous: pectus and medial feet with a few rufous spots; posterior feet black, venter rufous.

Bears considerable resemblance to "Saperda cinerea," *Oliv.*, iv. pl. 68, fig. 34.

PACHYTA, *Serv.* Muls., 237.

218. P. CORDIFERA, *Oliv.*, iv. pl. 73, fig. 41.

VAR. *lunaris*. Black, yellow tomentose; venter dull rufous; elytra yellow, apex, and a semi-circular macula behind the middle on the anterior margin, black. 6‴ long; 2 wide. Inhabits Pennsylvania. July.

Front clothed with yellow hair, frontal line impressed: prothorax much widened and bi-arcuate posteriorly, covered with yellow hair, and having the medial line obsolete: elytra divaricate and separately pointed at tip; a minute, black spot at the basal angle, and another (sometimes double) between it and the large medial macula.

The yellow covering is sometimes wanting, when the denuded parts appear black.

219. P. INSTABILIS, *Klug*.

Robust, black; elytra yellow, trimaculate with black, and having a common, cordate spot between the basal spots, which are united to the medial ones by a black line. 5‴ long; 2¼ wide. Inhabits Oregon. Cab. Le Conte.

220. P. ATTENUATA.

Black, thinly covered with olivaceous, prostrate hair: prothorax armed, elytra clouded with reddish-brown. 7‴ long; 2½ wide.

Front transversely concave before the antennæ, median line glabrous, eyes black; antennæ dull rufous; scapus and apex of the third, fourth, and fifth articulations black: prothorax minutely punctured, a slight, transverse groove anteriorly and posteriorly; dorsal line obsolete; an obsolete, glabrous tubercle upon each side of it; sides armed with a conspicuous, acute, tubercle: elytra narrowing rapidly to the apex, which is entire; sides rectilinear, surface shining, uneven, having distant, impressed punctures; colour reddish-brown, clouded with tomentose spots of a paler tint; feet with a tinge of rufous.

Found floating in Eagle Harbour, Kiweenaw Point, Lake Superior, by Dr. Le Conte, to whom I am indebted for the specimen described.

221. P. LITURATA, *Kirby*. Northern Zoology, p. 178.

222. P. THORACICA.

Brownish-black, front and pronotum ochraceous, elytra subquadrate. 5‴ long; 2 wide. Inhabits Penna. Rhagium thoracicum, *Mels.* Cat., No. 778. Pachyta sulcicollis? *Dej.* Cat., p. 381.

Head brownish-black, impressed between the antennæ; front, orbits, and labium ochraceous: prothorax yellow, tomentose above, transverse, pleura black; a wide, impressed, mesial line, with a tubercle each side of it, and another at the anterior angles; anterior margin and posterior one, near the scutel, black; scutel triangular, smooth: elytra parallel, obtusely conjointly rounded at tip, finely hirsute, and scabrous with numerous impressed, dilated punctures: beneath piceous, a pale-yellow, evanescent spot on the outer margin of the penultimate segment of the venter; epimera and episterna rufous; basal half of the tibiæ flavous.

223. P. SUBLINEATA.

Black, elytra and feet fulvous, extremity of the femora black. 4—4½‴ long; 1½ wide. Pennsylvania. Lake Superior.

Head minutely punctured, a fine, impressed line on the vertex, and between the antennæ; antennæ dark-reddish-brown: pronotum minutely punctured except along the medial line; a prominent tubercle in the posterior angles; scutel black, regularly triangular: elytra subparallel, minutely punctate, brownish fulvous, clothed with prostrate, fulvous hair; a rather prominent tubercle at the basal angles; apex truncate; an obscure, common, sutural band, and a second submarginal one.

224. P. RUFULA.

Black; antennæ, prosternum, feet, and elytra dull rufous. 4½‴ long; 1⅓ wide. Eagle Harbour. Dr. Le Conte.

Head and pronotum scabrous with confluent, impressed, punctures: prothorax armed with a slightly elevated tubercle; dorsal line obsolete; surface elevated each side posteriorly: elytra parallel, conjointly rounded at the apex, thickly covered with impressed, dilated, piliferous punctures: feet with piliferous punctures; dull rufous, tarsi and apex of the femora blackish.

225. P. CYANIPENNIS, *Say*. Journ. Acad. Nat. Sc., iii. 423. P. ione, *Newman*.

Inhabits Arkansas, Say; Massachusetts, Harris's Catalogue; and I have an individual from Kentucky.

226. P. LEONARDII, *Harris*.

Closely allied to the preceding, if not the male of that species. The antennæ are paler, the labrum and clypeus yellow, the elytra much narrower, and transversely and not obliquely truncate, as in *cyanipennis*. Inhabits Massachusetts and Pennsylvania. Very active; found upon Sambucus, in June.

227. P. DISCOIDEA.

Slender, black; elytra with the base, suture, and margins, dull rufous. 4‴ long; 1⅓ wide.

P. discoidea, *Dej.* Cat. Cab. Le Conte.

Head and pronotum with numerous, impressed punctures; posterior angles of the latter rising in a prominent tubercle: elytra margined with rufous, which is widest at base and narrowest along the suture; apex minutely and separately emarginate.

228. P. CHALYBÆA.

Black, elytra deep steel blue, antennæ and feet rufous. 2½—3‴ long; ¾—1 wide. Pennsylvania.

Leptura chalibæa, *Knoch.* Mels. Cat., No. 840.

Head minutely punctured, frontal line impressed: pronotum minutely punctured, medial line smooth, with a wide, shallow impression behind the middle; scutel black: elytra finely punctured, very slightly contracted in the middle; of a deep, shining, steel blue colour, tip separately rounded, leaving a sutural emargination.

STRANGALIA, *Serv.* Muls. 250.

229. S. LUTEICORNIS, *F.*, ii. 361. Oliv., iv. pl. 3, fig. 4. Mels. Cat., No. 822.

Yellow, pronotum with two and elytra with three black bands; tip of the posterior femora black; venter rufous. 5—6‴. Inhabits Massachusetts and Pennsylvania.

230. S. SEXNOTATA.

Dull rufous; palpi, antennæ, feet, pectus, and three elytral spots, black; elytra and femora yellow.
4½‴ long; 1¾ wide. S. 6-notata, *Dejean.*

231. S. OBSOLETA.

Like *luteicornis*, but having the basal elytral macula replaced by about three minute black spots; antennæ black; beneath black, yellow sericeous, abdomen rufous. 7‴ long; 1½ wide. Pennsylvania.

Head black; trophi, (except the maxillæ and labial palpi,) anterior margin of the labrum and clypeus, and a narrow, post-orbital band, yellow; labrum and clypeus punctured; an impressed frontal line, with an obsolete, yellow spot anteriorly; front with yellow hairs; occiput with a yellow spot: prothorax yellow above, with a black lateral band, abbreviated posteriorly; scutel black, with yellow hair: elytra minutely punctured, yellow, extreme sutural margin black, and two marginal maculæ, one in the middle, and the other between it and the tip, black: feet yellow, tarsi, tip of the tibiæ, and of the posterior femora, black.

VAR. S. *flaviceps*. Head above, and upon the sides, yellow. 5‴.

232. S. FAMILICA, *Newm.*

Like *obsoleta*: abdomen black, minute, elytral spots obsolete or wanting; posterior tibiæ piceous. 7‴ long. Inhabits Pennsylvania—Virginia. S. angustata, *Dej.*—nigricornis, *Mels.* MS.

Distinguished from *obsoleta*, in addition to the characters given above, by narrower elytra, a smaller medial, elytral spot, and the elongate, narrow form of the posterior one.

VAR. *confluenta*. Pronotum almost entirely black, from the confluence of the bands.

VAR. *solitaria*. Posterior elytral spot alone present. Alabama.

233. S. SUBHAMATA, *Randall.*

Black; femora, prosternum, and elytra yellow, these separately encircled with black, and having a transverse black band; ventral segments margined with obscure rufous.
6‴ long; 1¾ wide. S. lecontei, *Dejean.* L. interrupta, *Newman.*

Elytra with the black of the margin interrupted at the shoulder; apex deeply, conjointly emarginate; apical fourth black; antennæ, with the base of the six terminal articulations, yellow.

233½. S. BICOLOR, *Swederus.* Act. Holm. iii. 197, anno 1787. *Say*, Jour. Ac. N. Sc., iii. 418.

Say thought his species distinct from that of Swederus, because this "is said to be black on the upper part of the tail;" but it is possible that the black wings, appearing beneath the divarication of the elytra, were taken for the abdomen.

234. S. EMACIATA, *Newman.*

Slender, black, olivaceo-sericeous beneath, elytra pale-yellowish-brown. 5—6‴ long. Pennsylvania.
Leptura necydaloides, *Knoch.* Mels. Cat., No. 838.

Head shining black, minutely punctured, an indistinct, impressed line upon the front and vertex; labrum with a few yellow hairs; prothorax minutely punctured, sparsely clothed with shining, yellow hair, dorsal line indistinct: scutel black, with shining, yellow hair: elytra punctured throughout, and covered with short, sparse, prostrate hair: yellowish-brown, with a very narrow sutural and external margin of black; divaricate, obliquely emarginate on the inner side at tip, ending in a spine externally: wings translucent, gray: feet and abdomen black.

235. S. UNICOLOR.

Slender, black, punctured; a fovea near the posterior extremity of the dorsal line; beneath, olivaceo-sericeous. 5‴ long; 1 wide. Pennsylvania.

STENURA, *Dejean.*

236. S. EMARGINATA, *F.*, ii. 356. Oliv., pl. 3, fig. 6.

Black; elytra rufous, golden sericeous, apex black, separately emarginate. 14‴ long; 4 wide. Bost. Coll., No. 723.

Inhabits Carolina, appearing in July—August. The Reverend D. Ziegler has a specimen taken in Pennsylvania. According to Fabricius, it is a native of Cayenne.

237. S. OBLITERATA, *Klug.*

Obscure brown; thorax olivaceous hairy; elytra separately emarginate, obscure yellow, with a small, indistinct, black line near the base above, and another on the margin; a wide, transverse band at the middle, interrupted at the suture, and another posterior one uniting with the dull testaceous of the apex; feet yellow, posterior femora and tibiæ tipped with black. 7‴ long; 2½ wide. Oregon. Cab. Le Conte.

238. S. ZEBRATA, *Fabr.*, ii. 364—nitens? *Forster*, Cent. Ins., 45—quagga, *Germar.*

Black, golden sericeous, with four bright-yellow, elytral fasciæ; feet yellowish, antennæ *yellowish*-brown: palpi and head, in front of the antennæ, *yellow*. 6‴ long. Inhabits from Massachusetts to Pennsylvania, in May and June. Boston Collection, 597.

239. S. ZEBRA, *Oliv.*, pl. 3, fig. 33.

Closely allied to the preceding, but the region of the mouth and antennæ are *black*, the latter *dentate*, (as required by Olivier's description;) the pronotum is more roughly punctured, the elytra visibly scabrous, with the basal fascia more acutely curved, and the apex very obliquely reduced from the suture to the external angle.

5‴ long. Inhabits Carolina in April—July. Boston Coll., 595.

240. S. 8-NOTATA.

Black: elytra yellow, with four black maculæ, the third common; shoulder, feet, and apex of the abdomen brownish-yellow. 5‴ long; 1½ wide. Alabama.

Head and pronotum olivaceous hairy; palpi yellowish, terminal articulations of the maxillaries black; (antennæ dentate:) prothorax transverse, suddenly narrowed anteriorly: elytra slightly obliquely truncate, tipped with black; a basal and medial macula exteriorly, and another post-medial one narrowing forwards to the suture, along which it extends in a narrow line to near the base.

241. S. VELUTINA, *Oliv.*, pl. 3, fig. 32. Mels. Cat., 834. S. aurigera, *Newman.*

Black, olivaceo-sericeous; elytra dull rufous, with four yellowish spots or bands, tip separately emarginate: feet yellowish rufous, venter reddish, either entirely or at the tip. 6‴ long.

242. S. FUGAX, *Fabr.*, ii. 359.

General characters of the preceding. Elytra with the basal macula reduced in size, the second and third wanting, and the apical one evanescent; apex more obliquely narrowed from the suture; antennæ *dentate*. 4—5‴ long. Inhabits Pennsylvania.

This species bears nearly the same relation to *velutina* that *zebra* does to *zebrata*, and it is possible that the denticulation of the antennæ is a sexual distinction.

243. S. LURIDIPENNIS.

Rather slender, black; head and prothorax scabrous with confluent punctures, sides of the latter subrectilinear, tapering forwards; elytra with numerous, impressed punctures, dull yellowish-brown, apex blackish, scarcely truncate; beneath cinereo-sericeous.

♂ 4; ♀ 6‴ long; 1¾ wide. Pennsylvania. S. luridipennis, *Dej.* Catalogue.

244. S. NIGRELLA, *Say*, Journ. Acad. N. Sc., v. 279. Mels. Cat., No. 825.

245. C. ELEGANS, *Dej.* Cat.

Yellow, antennæ annulate, pronotum with a dark, longitudinal spot anteriorly, elytra with the suture and a medial fascia dark-brown. 7‴ long.

A drawing in Mr. Le Conte's collection.

246. S. AMERICANA.

Black, head and prothorax rufous, with fulvous hair; elytra parallel, slightly obliquely truncate.

4½‴ long; 1¼ wide. Pennsylvania. Leptura americana, *Mels.* Cat., No. 836. Stenura fulvicollis? *Dej.* Cat.

Head rufous, eyes, antennæ, and maxillary palpi black, the last with the articulations tipped with yellowish; a transverse, impressed line above the clypeus, and another behind the antennæ, the impressed frontal line uniting them; prothorax swelled above, very wide posteriorly, a large, transverse depression each side of the middle, on the posterior margin: elytra thickly covered with piliferous punctures; venter with a fulvous tinge, and clothed with fulvous hair.

247. S. ABDOMINALIS, *Dej.* Cat.

Black, venter fulvous, apex black. 8‴ long. A drawing in Major Le Conte's collection.

248. S. LUGUBRIS, *Say.* Journ. Acad. N. Sc., iii. 419. M. C., 833. Pennsylvania—June.

249. S. LUNATA, *Fabr.*, ii. 360. *Oliv.*, pl. 4, fig. 47. Mels. Cat., No. 834.

250. S. CINCTA.

Black; elytra truncate, flavous, apex, margin, suture, and an intermediate line, black; feet brownish or reddish-yellow, tarsi brown; antennæ annulate beyond the middle. 3½‴ long; 1 wide. Pennsylvania.

Leptura cincta, *Knoch*—lateralis, *Mels.* Cat., No. 823. Stenura lineolata, *Dej.* Catalogue.

Head sparsely covered with fine hair, particularly above, and in front of the antennæ; frontal line impressed, entire; palpi and anterior margin of the labrum and clypeus, yellow: prothorax campanuliform, elevated above, covered with small, piliferous punctures: elytra with dilated, impressed, piliferous punctures; sutural striæ, apex, and outer margin black, the last sometimes divided into three maculæ, from the posterior of which a black line runs along the disk to near the base.

VAR. *obsoleta.* Line of the disk, and black of the apex obsolete.

VAR. *lateralis.* Slender, (3½‴ long; ¾ wide,) line of the disk wanting, margin and apex black.

251. S. LINEOLA, *Say.* Journ. Acad. Nat. Sc., iii. 421. Mels. Cat., No. 832. Bost. Coll., 603.

Occurs from Massachusetts to Carolina, in May and June. Say found it in Mississippi.

252. S. ARMATA.

Black, elytra emarginate, exterior tip armed, a yellow, transverse line at the base, and extending in a vitta from the shoulder along the external margin posterior to the middle, interrupted near its extremity; sixth and following articulations of the antennæ annulate; mouth, base of the femora, and anterior face of the first pair, yellow. 5‴ long; 1¼ wide. Pennsylvania.

At first view this species might be taken for Leptura vittata, *Oliv.*

253. S. CRUENTATA.

Black, metathorax, venter, base of the posterior femora, and margin of the elytra (except at the base,) sanguineous; elytra black, thickly punctured, suture with a rufous tinge, and curving outwards towards the exterior apex, leaving a deep emargination.

$3\frac{1}{4}'''$ long; 1 wide. Pennsylvania. Leptura cruentata, *Knoch.* Mels. Cat., 841.

LEPTURA, *Lin.* Muls., 266.

254. L. CANADENSIS, *Oliv.*, pl. 23, fig. 27. Fabr., ii. 357. Mass., Penna.—August.

255. L. CINNAMOPTERA.

Size and habit of the preceding; elytra rufous, outer angle of the apex black.

L. erythroptera, *Kirby*, Northern Zoology, p. 180.

256. L. ERYTHROPTERA, *Zenker.* Germar's species, p. 522. L. rubrica, *Say*, Journ. Acad. Nat. Sci., iii. 418. Mels. Cat., No. 826. L. annulata, *Dej.*

Smaller than the preceding, less profoundly punctured, elytra entirely rufous. Makes its appearance in Pennsylvania in June.

257. L. TENUICORNIS.

Black, scabrous with confluent punctures, basal fourth of the elytra rufous; antennæ dentate, slender and longer than the body. $4\frac{1}{2}'''$ long; $1\frac{1}{2}$ wide. Cab. Le Conte.

Distinguished from *canadensis* by the long, slender antennæ, which are not annulate.

258. L. VAGANS, *Oliv.*, iv. pl. 73, fig. 46—axillaris, *Dej.*

Black, a triangular rufous macula at the external base of the elytra, these conjointly deeply emarginate, scarcely truncate. 3—4''' long.

259. L. MALACHITICUS.

Splendent green, scabrous with dilated, impressed punctures; antennæ and scutel black, trophi and feet testaceous, tarsi and outer half of the tibiæ brown; prothorax with a lateral tubercle; elytra entire.

$6\frac{1}{2}'''$ long; 2 wide. Pennsylvania.

This beautiful insect is in the cabinet of the Rev. Dr. Morris, who received it from Somerset County, Pennsylvania.

260. L. BIFORIS, *Newman.*

Yellowish-brown, or dull testaceous, elytra paler, with a black macula about the middle of the outer margin, and a small, obsolete one upon the margin, near the base.

6''' long; $1\frac{3}{4}$ wide. Pennsylvania—June. L. marginenotata, *Dej.* Catalogue.

Body covered with short, fulvous hair, somewhat sericeous beneath: head dark-brown; frontal line impressed, vertex scabrous; antennæ, feet, and beneath dull testaceous: prothorax subglobular, with fine, piliferous punctures; dorsal groove impressed: elytra taper, not divaricate, apex slightly obliquely truncate.

261. L. VITTATA, *Oliv.*, iv. pl. 73, fig. 45. Encyc., vii. 523. Mels. Cat., No. 829.

Occurs from Massachusetts to Alabama.

262. L. 4-PUNCTATA.

Black, villose; elytra slightly obliquely truncate, with a flavous, yellow spot behind the middle, near the suture, and another upon the suture near the apex; posterior feet, with the tarsi, and base of the femora, yellow.

6''' long; $1\frac{3}{4}$ wide. Pennsylvania. L. 4-punctata, *Mels.* Catalogue, No. 830.

263. L. PUBERA, *Say*. Journ. Acad. N. Sc., v. 279. Mels. Cat., No. 824. Pennsylvania.

264. L. CIRCUMDATA.

Black; elytra dull ochraceous, with a narrow margin of black. ♂ 3½‴ long; ⅘ wide. ♀ 3¾ long; 1⅕ wide. L. circumdata, *Dej.* Cat. Inhabits Pennsylvania.

Body covered with piliferous punctures, two or three articulations of the antennæ slightly annulate; prothorax convex above, dorsal line wanting: margin of the elytra interrupted at the shoulder.

265. L. 8-NOTATA, *Say*. Journ. Acad. N. Sc., iii. 419.

266. L. SCALARIS, *Say*. Journ. Acad. N. Sc., v. 278.

267. L. CHRYSOCOMA, *Kirby*, N. Z., 179, pl. 5, fig. 2.

268. L. SUBPUBESCENS, *Kirby*, N. Z., 180.

269. L. TENUIOR, *Kirby*, N. Z., 181.

270. L. BREVIS, *Kirby*, N. Z., 182.

271. L. SEXMACULATA, *Lin.* Kirby, N. Z., 182.

272. L. SEMIVITTATA, *Kirby*, N. Z., 183—abbreviata, *Germ. Schön.?*

273. L. GULOSA, *Kirby*, N. Z., 184.

274. L. SUBARGENTATA, *Kirby*, N. Z., 184.

275. L. SIMILIS, *Kirby*, N. Z., 185.

276. L. LONGICORNIS, *Kirby*, N. Z. 185.

277. L. PROTEUS, *Kirby*, N. Z., 186. L. biforis? *Newman.*

278. L. LONGICEPS, *Kirby*, N. Z., 187.

TRIGONARTHRIS, *Dejean.*

Distinguished from LEPTURA by the short, triangular articulations of the anterior and medial tarsi.

279. T. PROXIMA, *Say*. Journ. Acad. N. Sc., iii. 420—terminata, *Dej.*

Inhabits Pennsylvania and Missouri. ♂ 6‴ long; 2 wide. ♀ 8 long; 2¾ wide.

The prothorax is covered with impressed punctures, and sparse, upright, fulvous hairs, elytra finely punctured, tip slightly emarginate.

280. T. ATRATA, *Dejean*. Catalogue, p. 83. 8‴ long.

ANOPLODERA, *Mulsant*, 285.

281. A. 4-VITTATA, *Lin.*—vittata, *Say*. Helwig in Mels. Cat., No. 831. Penna.—June.

VAR. *pallida*. Colours paler, sutural vitta wanting.

GRAMMOPTERA, *Serv.* Muls., 289.

282. G. CAPITATA, *Newman*. (Leptura.) G. sanguinicollis, *Dej.*

Black, head and prothorax bright rufous. 3—4‴ long.

283. G. SPHÆRICOLLIS, *Say*. Journ. Acad. Nat. Sc., v. 280. G. discicollis, *Dej*.—pauperecula, *Newman*.

284. G. RUFICOLLIS, *Say*. Journ. Acad. Nat. Sci., iii. 421—collaris, *Mels*. Cat., No. 842. Boston Collection, 1247. Extends from Massachusetts to Carolina.—April.

NOTE.—An entomological article in the Boston Journal of Natural History, Vol. II., containing descriptions of ten species of Longicornia, by Mr. Randall, was overlooked until this paper had been presented to the society: and also one by Mr. Newman, in the Entomological Magazine, Vol. II. The latter contains a number of species of Elaphidion, some of which are probably redescribed. Several new species will be found described by me in the Proceedings of the Acad. Nat. Sci., Vol. III.

INDEX.

	Page		Page		Page		Page
Acanthoderes,	45	Desmiphora,	50	Lypsimena,	54	Prionus,	31
Ægomorphus,	45	Desmocerus,	58	Mallodon,	30	Ptychodes,	53
Amniscus,	46	Diozodes,	42	Molorchus,	44	Purpuricenus,	31
Amphionycha,	57	Distenia,	57	Monohammus,	51	Rhagium,	58
Anærea,	55	Dorcaschema,	54	Moneilema,	45	Rhamnusium,	58
Ancylocera,	44	Eburia,	32	Necydalis,	44	Saperda,	55
Anoplium,	34	Elaphidion,	32	Nothrus,	43	Smodicum,	38
Anoplodera,	65	Eriphus,	39	Oberea,	56	Stenocorus,	32
Arhopalus,	36	Exocentrus,	50	Obrium,	42	Stenopterus,	44
Asemum,	35	Grammoptera,	65	Oncideres,	52	Stenosphenus,	39
Astynomus,	46	Hebestola,	54	Orthosoma,	31	Stenostola,	56
Ataxia,	56	Heterachthes,	43	Pachyta,	59	Stenura,	62
Atimia,	56	Hetœmis,	54	Phymatodes,	37	Stizocera,	43
Callichroma,	31	Hippopsis,	54	Physocnemum,	38	Strangalia,	61
Callidium,	36	Hylotrupes,	36	Phytœcia,	57	Tetraopes,	53
Cerasphorus,	32	Hyperplatys,	49	Plectrodera,	52	Toxotus,	58
Clytus,	39	Ibidion,	44	Plectromerus,	43	Tragidion,	35
Compsidea,	55	Lamia,	52	Pogonocherus,	50	Trigonarthris,	65
Criocephalus,	35	Leiopus,	50	Polyopsia,	55	Tylonotus,	37
Derobrachus,	31	Leptura,	64				

ARTICLE IV.

Description of New Fresh Water and Land Shells. By Isaac Lea. Read May 2d, 1845.

The rich Fauna of our country, not yet completely explored, gives me the opportunity of again presenting myself before the Society with descriptions of many new organisms of an interesting nature to the zoologist. The unexplored portions of Tennessee, Alabama, and Louisiana contribute nearly the whole of the species composing this paper—some of them of more than ordinary interest. It will be observed that I have now added twenty-three new species to the already long list of the *Melaniæ*, my last paper containing fifty-seven. I also add six to the interesting genus *Schizostoma*—now making ten species in all—and twenty-six to the family *Naiades*.

In the investigation and necessary research to make myself acquainted with the genus *Melania*, I have necessarily looked up the names of all the known species, and for my own convenience have made an alphabetic list, which I propose to append, for the convenience of those who study this genus. The whole consists of three hundred and ninety-five names, by various authors, but I do not mean to be understood that these are all distinct species—a few are doubtless duplicated. Part of them are fossil.

Regarding my own species, it will be observed that, among some of them, there is a strong alliance; but I have abstained from considering them as typical where I could not find what I presumed to be a constant character. At the same time, I am perfectly aware of the extreme difficulty of separation, arising from the fact of the existence of the vast number of species now described as belonging to this genus, and their consequent inosculation. Where my mind was satisfied, however, after a close and careful examination, that their characteristics were persistent, I have put them down with confidence that they would, in the main, be found to be correct.

Unio hippopæus. Pl. I. Fig. 1.

Testâ plicatâ, ellipticâ, valde inflatâ; valvulis subcrassis: natibus prominulis; epidermide luteo-fuscâ, striatâ; dentibus cardinalibus subgrandibus; lateralibus parvis curvisque; margaritâ albâ et iridescente.

Shell elliptical, folded, much inflated; valves rather thick; beaks rather prominent; epidermis yellowish-brown, striate; cardinal teeth rather large; lateral teeth small and curved; nacre white and iridescent.

Hab. Lake Erie—B. W. Budd, M. D.

My cabinet and cabinet of Dr. Budd.

Diam. 1.1, Length 1.5, Breadth 2.1 inches.

Shell elliptical, with a few folds on the middle of the disk, and much inflated; substance of the shell rather thick, thinner behind; beaks rather prominent; ligament short and thick; epidermis yellowish-brown and much striate; cardinal teeth rather larger, double in the left and disposed to be treble in the right valve; lateral teeth small, somewhat bladed and curved; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed on the under side of the cardinal tooth; cavity of the shell large and rounded; cavity of the beaks deep and angular; nacre white and iridescent.

Remarks.—This is a small, undulated species, most nearly allied to *U. plicatus*, Lesueur. A single one only is before me for examination, but Dr. Budd informs me that he received about twenty specimens, all bearing the same characters. Had a single specimen only been observed, I should have been disposed to consider it a stunted *plicatus*, with more inflation than usual, and with less development of the folds.

Unio latecostatus. Pl. I. Fig. 2.

Testâ crebrè plicatâ, elliptică, compressâ; valvulis crassis; natibus prominulis; epidermide tenebroso-fuscâ, valdè striatâ; dentibus cardinalibus magnis; lateralibus longis subrectisque; margaritâ albâ et valdè iridescente.

Shell much folded, elliptical, compressed; valves thick; beaks slightly prominent; epidermis dark-brown, much striated; cardinal teeth large; lateral teeth long and nearly straight; nacre white and very iridescent.

Hab. Tuscaloosa, Alabama. B. W. Budd, M. D.

My cabinet and cabinet of Dr. Budd.

Diam. 1.3, Length 2.5, Breadth 3.5 inches.

Shell very much folded over the whole disk, with thick ribs, visible on the inside, remarkably oval, much compressed; substance of the shell thick before, thinner behind; beaks scarcely prominent; ligament long and rather thick; epidermis very dark-brown, nearly black and much striate; cardinal teeth very large and thick, double in the left and single in the right valve; lateral teeth long, rather thin, and nearly straight; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed on the under side of the cardinal tooth; cavity of the shell very shallow; cavity of the beaks shallow and somewhat angular; nacre white, tinged with purple on the posterior margin, and very iridescent.

Remarks.—But two specimens of this species were received by Dr. Budd, and my cabinet is indebted to him for one of them. The large, regular, and thick fold, and regular oval margin distinguish this shell from the proximate species. It is perhaps most closely allied to *U. undulatus*, Barnes, but may be distinguished at once by its oval form, and the number and regularity of its folds or ribs, which are remarkably parallel. The posterior portion of the valves being rather thin, causes the thick ribs to be impressed on the inside, which has a very unusual and brilliant iridescence, tinged with purple in the nacre. The cardinal teeth are very large in proportion to the lateral teeth.

1 Unio hippopæus.
2 Unio latecostatus
3 Unio utriculus

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Sinclair's Lith. Phila

4 *Unio hyalinus*
5 *Unio atrocostatus*
6 *Unio pellucidus*

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Sinclair's Lith. Phil.

Unio utriculus. Pl. I. Fig. 3.

Testâ lævi, ellipticâ, inflatâ; valvulis subcrassis: natibus subprominentibus; epidermide tenebroso-fuscâ; dentibus cardinalibus parvis; lateralibus longis rectisque: margaritâ alba et valdè iridescente.

Shell smooth, elliptical, inflated; valves rather thick; beaks rather prominent; epidermis dark-brown; cardinal teeth small; lateral teeth long and straight; nacre white and very iridescent.

Hab. North Carolina. B. W. Budd, M. D.

My cabinet and cabinet of Dr. Budd.

Diam. .8, Length 1.1, Breadth 1.7 inches.

Shell smooth, regularly elliptical, inflated, very inequilateral, obscurely angular on the umbonial slope; substance of the shell thick before and thin behind; beaks rather prominent; ligament short and thin; epidermis very dark-brown, without rays, and with regular, nearly equidistant lines of growth; cardinal teeth very small, erect, and sharp; lateral teeth long and straight; anterior cicatrices distinct; posterior cicatrices distinct; dorsal cicatrices placed on the under side of the cardinal tooth; cavity of the shell rather deep and rounded; cavity of the beaks shallow and rounded; nacre very white and beautifully iridescent.

Remarks.—Two specimens of this species were received by Dr. Budd. They came with the others from North Carolina, and no doubt from one of the tributaries of the Tennessee river. This species has some resemblance to *U. Vanuxemensis*, (Nobis,) and *U. glans*, (Nobis,) but need not be confounded with either of them. It is less flat than the former, and not so much inflated as the latter, and is dissimilar to each in having a white nacre.

Unio hyalinus. Pl. II. Fig. 4.

Testâ lævi, obovatâ, subinflatâ, diaphanâ; valvulis pertenuibus; natibus prominulis, ad apices undulatis; epidermide tenebroso-fuscâ; dentibus cardinalibus parvis, compressis; lateralibus longis rectisque; margaritâ cæruleo-albâ et iridescente.

Shell smooth, obovate, subinflated, transparent; valves very thin; beaks slightly prominent, undulated at the beaks; epidermis dark-brown; cardinal teeth small and compressed; lateral teeth long and straight; nacre bluish-white and iridescent.

Hab. Richmond, Virginia. Major Le Conte.

Cabinet of Major Le Conte.

Diam. .5, Length .9, Breadth 1.4 inches.

Shell smooth, obovate, rather inflated, transparent; carinate on the posterior slope; substance of the shell very thin; beaks slightly prominent, minutely undulated at the tips; ligament very short and thin; epidermis dark-brown and obscurely rayed; cardinal teeth single in the right valve and slightly cleft in the left valve; lateral teeth single in both valves, long and compressed; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed immediately on the centre of the cavity of the beaks; cavity of the shell rather shallow; cavity of the beaks very shallow and angular; nacre bluish-white and iridescent.

Remarks.—Major Le Conte placed in my hands a single specimen of this species, which he procured from Richmond. It is a distinct and peculiar species which cannot be easily

confounded with any other, except one from the Chatahoochee, for which I propose the name of *pellucidus*. It is more triangular than that shell, and differs in the peculiarity of the lateral teeth in both valves being single, while in that shell it is double in the right valve.

Unio atro-costatus. Pl. II. Fig. 5.

Testâ plicatâ, subquadratâ, inflatâ; valvulis crassis; natibus prominentibus; epidermide nigrâ, striatâ; dentibus cardinalibus magnis; lateralibus sublongis subrectisque; margaritâ albâ et irideseente.

Shell folded, somewhat quadrate, inflated; valves thick; beaks somewhat prominent; epidermis black and striate; cardinal teeth large; lateral teeth rather long and nearly straight; nacre white and iridescent.

Hab. Claiborne, Alabama—Judge Tait. Tuscaloosa, Alabama—B. W. Budd, M. D. Alexandria, Louisiana—Josiah Hale, M. D.

My cabinet and cabinets of Dr. Budd and Dr. Hale.

Diam. 1.6, Length 2.5, Breadth 3 inches.

Shell folded, somewhat quadrate, inflated; substance of the shell thick, thinner behind; beaks large, rounded, and rather prominent; ligament rather short and thick; epidermis black and striate; cardinal teeth very large, thick, and wide, double in the left and disposed to be treble in the right valve; lateral teeth rather long and nearly straight; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices on the under side of the plate near to the cardinal tooth; cavity of the shell rather deep and rounded; cavity of the beaks shallow and angular; nacre white and iridescent.

Remarks.—The late Judge Tait sent me several specimens of this species, many years ago, and subsequently I have received specimens from Drs. Hale and Budd, which have cleared up my previous doubts of its being distinct from its allied species *U. undulatus*, Barnes. It may be distinguished by the outline of *atro-costatus* being more rounded—scarcely taking a quadrate form—in having a more elevated umbo, and in being quite black, where the individual is mature—the young being usually a dark-green.

The specimens, six in number, sent to me by Dr. Budd, are all from Tuscaloosa, and are only slightly folded, the surface of the disk presenting small, irregular undulations, which give it a somewhat varicose or subnodose appearance. The largest of them is only two and a half inches wide, while the largest from Claiborne is nearly five inches wide. There is a slight purple tint on the posterior margin of those from Alexandria.

Unio pellucidus. Pl. II. Fig. 6.

Testâ lævi, obovatâ, subcompressâ, pellucidâ; valvulis pertenuibus; natibus prominulis, ad apices undulatis; epidermide tenebroso-fuscâ; dentibus cardinalibus parvis, compressis erectisque; lateralibus longis, rectis lamellatisque; margaritâ cærulco-albâ et iridescente.

Shell smooth, obovate, rather compressed, pellucid; valves very thin; beaks slightly prominent, undulated at the beaks; epidermis dark-brown; cardinal teeth small, compressed, and erect; lateral teeth long, straight and lamellar; nacre bluish-white and iridescent.

Hab. Chatahoochee river, Georgia. Major Le Conte.

Cabinet of Major Le Conte.

Diam. .5, Length .8, Breadth 1.3 inches.

Shell smooth, obovate, rather compressed, pellucid, very inequilateral, rounded and enlarged over the umbonial slope; substance of the shell very thin; beaks slightly prominent, minutely undulated at the tip; ligament very short and thin; epidermis dark-brown, and rayed nearly over the whole disk; cardinal teeth single in the right and double in the left valve; lateral teeth double in the right and single in the left valve, long, straight, and lamellar; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed under the plate near to the cardinal tooth; cavity of the shell shallow; cavity of the beaks shallow and rounded; nacre bluish-white and very iridescent.

Remarks.—A single specimen only of this species is before me. It is allied to *U. hyalinus*, described herein, but may be distinguished at once by the form of the teeth, particularly the lateral one, which, in that shell, has the remarkable character of being single in both valves. In the *hyalinus* the carina of the posterior slope is much higher. In the specimen under examination the space about the cavity of the beaks is rubiginose. This may not be a prominent characteristic. The cardinal tooth of the left valve is peculiarly formed, having the superior portion very small, and almost forming a portion of the dorsal line.

Unio tumescens. Pl. III. Fig. 7.

Testâ lævi, triangulari, inflatâ; valvulis percrassis, natibus magnis elevatisque; epidermide tenebroso-fuscâ, radiatâ; dentibus cardinalibus parvis; lateralibus brevibus, crassis subcurvisque; margaritâ albâ et iridescente.

Shell smooth, triangular, inflated; valves very thick; beaks large and elevated; epidermis dark-brown, radiated; cardinal teeth small; lateral teeth short, thick and somewhat curved; nacre white and iridescent.

Hab. Alexandria, Louisiana. J. Hale, M. D.

My cabinet and cabinets of Dr. Hale and T. G. Lea.

Diam. .1, Length 1.3, Breadth 1.5 inches.

Shell smooth, triangular, inflated, flattened on the side from the beaks to the margin, angular on the umbonial slope, nearly equilateral; substance of the shell very thick, thinner behind; beaks large and elevated; ligaments short and thick; epidermis dark-brown, finely striate, and with green rays reaching to the margin; cardinal teeth small, and rather erect; lateral teeth short, thick, and somewhat curved, thickened at the posterior end; anterior cicatrices distinct; posterior cicatrices distinct; dorsal cicatrices placed under the cardinal tooth; cavity of the shell shallow, cavity of the beaks shallow and rounded; nacre white and iridescent.

Remarks.—This species is allied to *U. trigonus*, (Nobis,) and *U. Edgarianus*, (Nobis,) and somewhat resembles *U. obliquus*, Lam. It differs from *trigonus* in being more rounded and in having rays. It is fuller than *Edgarianus*, and is rayed somewhat like it. I have but one perfect specimen and a single odd valve of this species, and in all these three valves the superior posterior cicatrix is remarkably deep and round.

Unio pernodosus. Pl. III. Fig. 8.

Testâ pernodosâ, rotundatâ, subcompressâ; valvulis crassis; natibus elevatis; epidermide luteo-fuscâ; dentibus cardinalibus magnis; lateralibus brevibus, crassis subrectisque; margaritâ albâ.

Shell very nodulous, rounded, rather compressed; valves thick; beaks elevated; epidermis yellowish-brown; cardinal teeth large; lateral teeth short, thick and nearly straight; nacre white.

Hab. North Carolina. B. W. Budd, M. D.

My cabinet and cabinet of Dr. Budd.

Diam. 1.4, Length 2.2, Breadth 2.4 inches.

Shell tuberculate nearly all over, rounded, rather compressed on the sides and towards the margin; substance of the shell thick, thinner behind; beaks elevated; ligament rather short and thick; epidermis yellowish-brown, striate, and crimpled; posterior slope impressed and thickly tuberculate; anterior slope nearly free from tubercles; cardinal teeth large, wide, and double in both valves; lateral teeth short, thick, and nearly straight; anterior cicatrices distinct; posterior cicatrices distinct; dorsal cicatrices placed on the under side of the cardinal tooth; cavity of the shell shallow; cavity of the beaks rather deep and angular; nacre white.

Remarks.—Three specimens of this species were sent to me by Dr. Budd, labelled "North Carolina." They are evidently from that portion of the state which is drained by the tributaries of the river Tennessee, and were accompanied by species common to the Holston, &c. In this we have another species which must be placed in the group which Mr. Barnes' *verrucosus* must be considered to form the type. It certainly is more nearly allied to that species than any other. It differs, however, from it in having a white nacre, instead of a chocolate-coloured one—in having smaller and more frequent tubercles, and in being more rounded in the outline. It differs from *Cooperianus*, (Nobis,) in the tubercles being smaller, more frequent, and in being more compressed. In the three specimens before me there is no indication of flesh colour, which usually is found in the *Cooperianus*. There is no indication of any rays on these specimens, and the beaks of all of them being eroded, they do not present the opportunity of observing their normal undulations.

Unio flavescens. Pl. III. Fig. 9.

Testâ lævi, elliptică, subinflatâ; valvulis subtenuibus; natibus subprominentibus; epidermide luteo-cornea, striatâ; dentibus cardinalibus parvis; lateralibus sublongis, subrectisque; margaritâ albâ et iridescente.

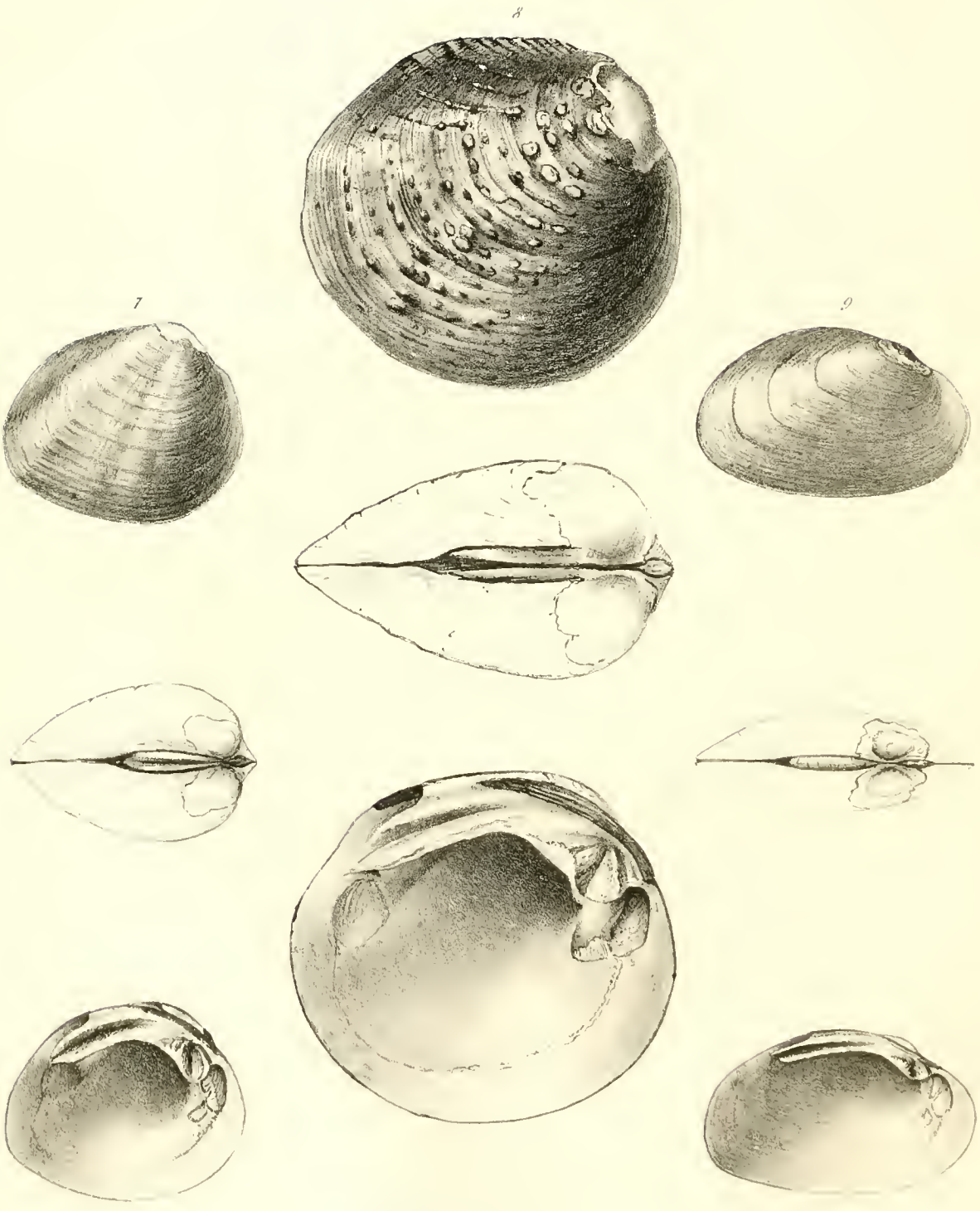
Shell smooth, elliptical, somewhat inflated; valves rather thin; beaks somewhat prominent; epidermis yellowish horn colour, striate; cardinal teeth small; lateral teeth rather long and nearly straight; nacre white and iridescent.

Hab. Black Warrior river, Alabama. B. W. Budd, M. D.

My cabinet and cabinet of Dr. Budd.

Diam. .7, Length 1.1, Breadth 1.7 inches.

Shell smooth, elliptical, somewhat inflated, inequilateral, obscurely angular on the umbonial slope, and flattened on the side; substance of the shell rather thick, thinner behind; beaks rather prominent; ligament rather short and thin; epidermis yellowish horn colour, striate, shining, and without rays; cardinal teeth very small, single in the right and double in the left valve; lateral teeth rather long and nearly straight, thickened at the posterior end; anterior cicatrices distinct; posterior cicatrices distinct; dorsal cicatrices placed nearly in the centre of the cavity of the beaks; cavity of the shell rather shallow and rounded; cavity of the beaks shallow and rounded; nacre white and iridescent.



7. Unio tumescens
8. Unio pernodosus
9. Unio flavescens.

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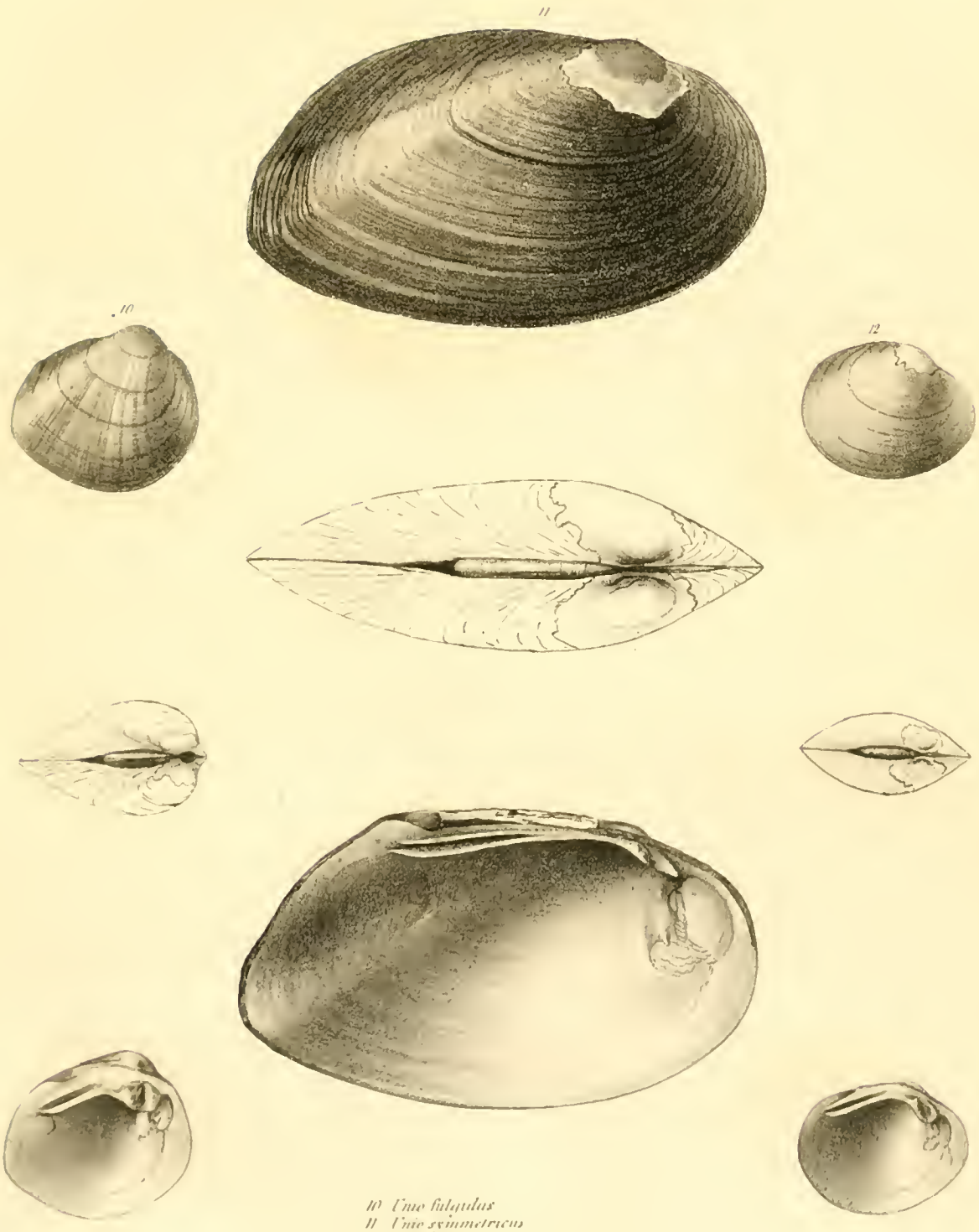


10 *Unio fulgidus*
11 *Unio asymmetricus*
12 *Unio unicolor.*

Sinclair's Lith. Phil.

Remarks.—Dr. Budd submitted three specimens of this species to my inspection. They are of various ages, and neither of them have a single ray. The youngest is more yellow than the others. It is nearly allied to *U. simplex*, herein described, but differs from that species in being less heavy, in having no rays, and in being flatter on the side. It answers nearly to the description of Mr. Conrad's *U. Greenii*, but does not agree with his figure, which is more rounded, and has rays.

Unio fulgidus. Pl. IV. Fig. 10.

Testâ lævi, triangulari, inflatâ; valvulis crassis; natibus magnis elevatisque; epidermide tenebroso-fuscâ, politâ, radiatâ: dentibus cardinalibus parvis: lateralibus crassis rectisque; margaritâ albâ et iridescente.

Shell smooth, triangular, inflated; valves thick; beaks large and elevated; epidermis dark-brown, polished, rayed; cardinal teeth small; lateral teeth thick and straight; nacre white and iridescent.

Hab. Alexandria, Louisiana. J. Hale, M. D.

My cabinet and cabinets of Dr. Hale and T. G. Lea.

Diam. .8, Length 1.1, Breadth 1.2 inches.

Shell smooth, triangular, inflated, subangular on the umbonial slope, nearly equilateral; substance of the shell thick, thinner behind; beaks large and elevated; ligament short and thin; epidermis dark-brown, finely polished, with obscure rays, and regular, equidistant marks of growth; cardinal teeth small, lateral teeth short, thick, and straight; anterior cicatrices distinct; posterior cicatrices distinct; dorsal cicatrices placed nearly in the centre of the cavity of the beaks; cavity of the shell very shallow; cavity of the beaks shallow and subangular. Nacre white and iridescent.

Remarks.—This is a small species of which I received one specimen and an odd valve from my brother, T. G. Lea, who received them from Dr. Hale. This species is allied to *U. tumescens*, (Nobis,) herein described. It differs in being less flattened on the sides, in not having an angular umbonial slope, in having a more fine polish, and in the rays being more obscure.

Unio symmetricus. Pl. IV. Fig. 11.

Testâ lævi, oblongâ, subcompressâ; valvulis subcrassis; natibus subprominentibus; epidermide tenebroso-fuscâ: dentibus cardinalibus compressis, elevatis, acuminatis; lateralibus longis, lamellatisque; margaritâ albâ.

Shell smooth, oblong, rather compressed; valves somewhat thick; beaks somewhat prominent; epidermis dark-brown; cardinal teeth compressed, elevated, and pointed; lateral teeth long and lamellar; nacre white.

Hab. Red River, at Alexandria, Louisiana. J. Hale, M. D.

My cabinet and cabinet of Dr. Hale.

Diam. 1.1, Length 1.8, Breadth 3.2 inches.

Shell smooth, oblong, rather compressed, angular behind and rounded before, carinate on the posterior slope; substance of the shell rather thick and regular on the interior surface; beaks somewhat prominent; ligament very long and rather thin; epidermis dark-brown, polished on the umbones, and wrinkled along the margin; cardinal teeth compressed, elevated, pointed, single in the right and double in the left valve; lateral teeth long, lamellar, thickened in the left valve and slightly recurved; anterior cicatrices distinct;

posterior cicatrices confluent; dorsal cicatrices numerous, deep, and placed in the centre of the cavity of the beaks; cavity of the shell rather shallow; cavity of the beaks shallow and angular; nacre white.

Remarks.—Three specimens of this species have been recently sent to me by Dr. Hale. It belongs to the group of which Mr. Say's *camptodon* may be considered as the type, and which includes his *declivis* and *tetralasmus*—if the latter be a true species, of which I am unable to decide, never having seen a specimen of it. In all the three specimens before me the outline is remarkably regular and uniform, and very closely resembles the *declivis*, but the angle is less acute. In the three there is no appearance of rays—one of them is inclined to yellow. The margin of the interior surface is rather broad and dark. The two impressed lines, from the beak to the posterior margin which exist in so many species, are rather more marked than usual. A specimen in Dr. Griffith's cabinet, supposed to be Mr. Conrad's *U. excultus*, approaches very closely to this species, and it may prove, when more perfect individuals are found and compared, to be only a variety.

Unio unicolor. Pl. IV. Fig. 12.

Testâ lævi, subrotundâ, subcompressâ; valvulis crassis; natibus subprominentibus; epidermide fuscâ; dentibus cardinalibus parvis; lateralibus longis subrectisque; margaritâ albâ et iridescente.

Shell smooth, nearly round, rather compressed; valves thick; beaks slightly prominent; epidermis brown; cardinal teeth small; lateral teeth long and nearly straight; nacre white and iridescent.

Hab. Tuscaloosa, Alabama. B. W. Budd, M. D.

Cabinet of Dr. Budd.

Diam. .5, Length .8, Breadth 1.1 inches.

Shell smooth, nearly round, rather compressed and somewhat lenticular; substance of the shell thick, thinner behind; beaks but slightly prominent; ligament short and thin; epidermis rather dark-brown, with very fine, shining striæ; cardinal teeth small, single in the right and double in the left valve; lateral teeth long and nearly straight; anterior cicatrices confluent; posterior cicatrices confluent; dorsal cicatrices on the under side of the plate near the cardinal tooth; cavity of the shell rather shallow and regularly rounded; cavity of the beaks small and slightly angular; nacre very white and iridescent.

Remarks.—This is a very small species, with characteristics more nearly resembling *U. lens*, (Nobis,) than any other with which I am acquainted. One specimen only was sent to me by Dr. Budd.

Unio approximus. Pl. V. Fig. 13.

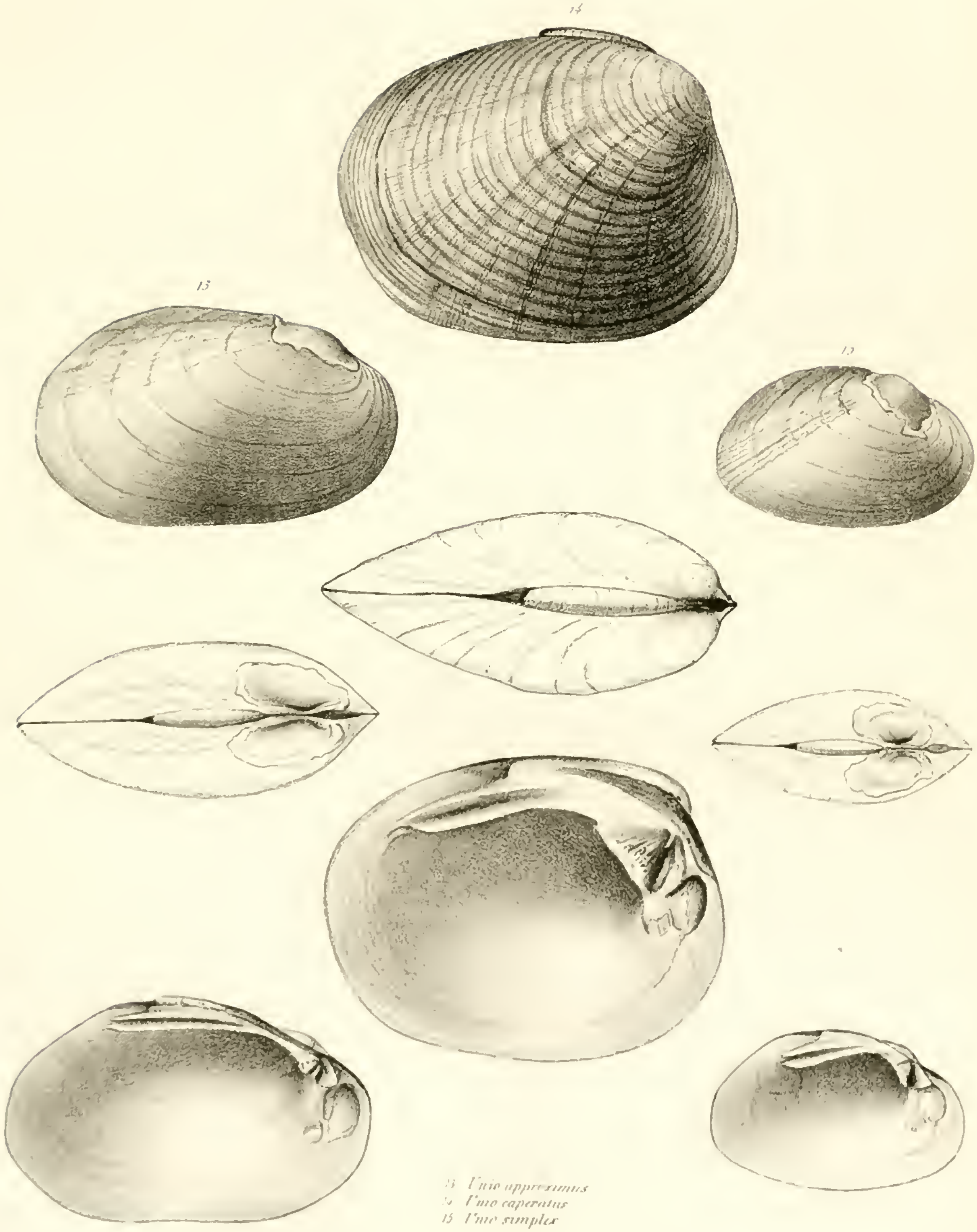
Testâ lævi, ellipticâ, inflatâ; valvulis subcrassis; natibus prominulis; epidermide luteâ, radiatâ; dentibus cardinalibus parvis, acuminatis; lateralibus longis, subrectisque; margaritâ albâ et iridescente.

Shell smooth, elliptical, inflated; valves rather thick; beaks somewhat prominent; epidermis yellow, radiated; cardinal teeth small, pointed; lateral teeth long and nearly straight; nacre white and iridescent.

Hab. Red River, at Alexandria, Louisiana. J. Hale, M. D.

My cabinet and cabinet of Dr. Hale.

Diam. .1, Length 1.3, Breadth 2.2 inches.



13 Unio approximus
14 Unio caperatus
15 Unio simplex

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Shell smooth, elliptical, inflated, rounded before and behind; substance of the shell rather thick; beaks somewhat prominent, nearly terminal; ligament rather long and thin; epidermis yellow, somewhat polished, smooth, with small rays; cardinal teeth double in both valves, erect, pointed; lateral teeth long, nearly straight, lamellar; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed across the centre of the cavity of the beaks; cavity of the shell rather deep and rounded; cavity of the beaks deep and angular.

Remarks.—Dr. Hale has twice sent me this shell, from the Red River, and I have now four specimens before me. I thought when I first received a specimen, some years since, that it was a variety of *Hydiana*, but it differs from that species in being much less ponderous, in the beaks being more terminal, and in being less rayed. These are also smaller. The rays are stronger on the posterior slope. One of the specimens is rayed nearly over the whole disk—another has rays only on the posterior part.

Unio caperatus. Pl. V. Fig. 14.

Testâ lævi, obliquâ, compressâ; valvulis crassis; natibus elevatis; epidermide rufo-fuscâ; dentibus cardinalibus percrassis; lateralibus longis, à cardinalibus separatis, crassis curvisque; margaritâ albâ.

Shell smooth, oblique, compressed; valves thick; beaks elevated; epidermis reddish-brown; cardinal teeth very thick; lateral teeth long, (being separated from the cardinal teeth,) thick, and curved; nacre white.

Hab. Clinch River, Tennessee. President Estabrook.

My cabinet and cabinets of Mr. Estabrook and Dr. Foreman.

Diam. 1.2, Length 1.9, Breadth 2 5 inches

Shell smooth, oblique, compressed, flattened on the umbones, very inequilateral, surface of the shell thick, thinner behind; beaks elevated; ligament rather long and thick; epidermis reddish-brown, wrinkled, with numerous, irregular, capillary rays; cardinal teeth very thick, large, and disposed to be double in both valves; lateral teeth long, (being separated from the cardinal teeth,) thick, curved, and enlarged at the posterior end; anterior cicatrices distinct; posterior cicatrices distinct; dorsal cicatrices placed under the plate near the cardinal tooth; cavity of the shell shallow; cavity of the beaks deep and angular; nacre white.

Remarks.—I have three specimens of this interesting species before me. They are all mature shells, and a good deal eroded. It belongs to that group of which the *U. irroratus*, (Nobis,) may be considered the type, having the correlative characteristics. It will stand between *irroratus* and *dromas*. From the first it differs in being oblique, and more compressed—from the latter in being smaller, flatter, and not having the humps on the umbones. The capillary rays seem to spread over the whole disk, but the specimens being old and worn, that notable character is nearly obliterated. The colour of the epidermis, in younger specimens, will no doubt be found to be greenish and yellow, and the rays very beautiful, as in the *irroratus*. Two specimens of the three have a tint of salmon-colour in the nacre of the posterior portion The plate from the beak to the margin, between the cardinal and lateral teeth, is large and flat, and the space between the two teeth very much arched. It is very evident, from the lines of growth, that the young are nearly round, the disk becoming protruded and patulous, when old.

Unio simplex. Pl. V. Fig. 15.

Testâ lævi, elliptică, subinflatâ; valvulis subcrassis: natibus subprominentibus; epidermide luteâ; dentibus cardinalibus parvis; lateralibus longis, crassis subrectisque; margaritâ albâ et iridescente.

Shell smooth, elliptical, somewhat inflated; valves rather thick; beaks somewhat prominent; epidermis yellow; cardinal teeth small; lateral teeth long, thick, and nearly straight; nacre white and iridescent.

Hab Black Warrior River, Alabama. B. W. Budd, M. D.

My cabinet and cabinet of Dr. Budd.

Diam. .7, Length .1, Breadth 1.6 inches.

Shell smooth, elliptical, somewhat inflated, rounded and full on the umbonial slope; substance of the shell rather thick, thinner behind; beaks rather prominent; ligament long and narrow; epidermis yellow, shining, and finely striate, with a few capillary rays on the posterior slope; cardinal teeth very small, single in the right and double in the left valve, crenate; lateral teeth long, thick at the posterior end, and nearly straight; anterior cicatrices distinct; posterior cicatrices distinct; dorsal cicatrices placed on the under side of the cardinal tooth; cavity of the shell rather deep; cavity of the beaks rather shallow and rounded; nacre very white and iridescent.

Remarks.—Two specimens of this species were placed under my notice, by Dr. Budd. It has somewhat the aspect of *U. Hydianus*, (Nobis,) but differs in being less transverse and having a more striate surface, and being without the numerous beautiful rays which so generally prevail in that species. Both the specimens before me have the same capillary rays on the posterior slope, and none whatever on the other portions of the disk. The lateral tooth is remarkable for the thickness on the inferior side of the posterior end.

Unio Gouldii. Pl. VI. Fig. 16.

Testâ lævi, elliptică, subinflatâ, inequilaterali; valvulis subcrassis; natibus prominulis; epidermide tenebroso-fuscâ; dentibus cardinalibus parvis, subcrassis; lateralibus longis curvisque; margaritâ subaureâ et valdè iridescente.

Shell smooth, elliptical, somewhat inflated, inequilateral; valves rather thick; beaks slightly prominent; epidermis dark-brown; cardinal teeth small and thick; lateral teeth long and curved; nacre somewhat golden and very iridescent.

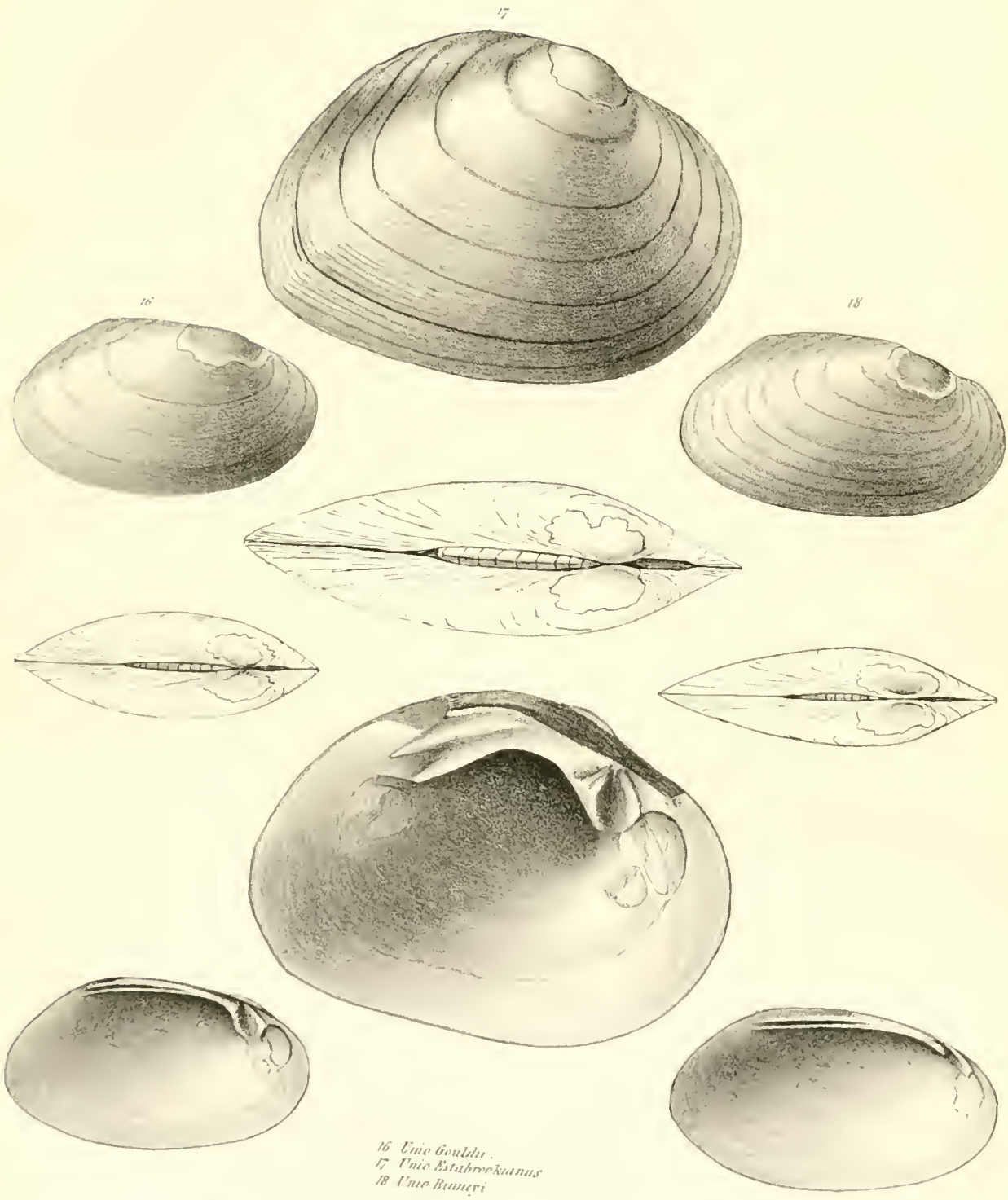
Hab. Tuscaloosa, Alabama. R. E. Griffith, M. D.

Cabinet of R. E. Griffith, M. D.

Diam. .7, Length 1.1, Breadth 1.9 inches.

Shell smooth, elliptical, somewhat inflated, inequilateral, rounded before and obtusely angular behind; substance of the shell rather thick, thinner before; beaks slightly prominent; epidermis dark-brown, without rays; cardinal teeth small and thick, double in both valves; lateral teeth long, curved in the left valve, the superior one considerably shorter than the inferior one; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed on the plate under the cardinal teeth; cavity of the shell rather shallow; cavity of the beak rather shallow and angular; nacre very soft, satin like, somewhat golden, and very iridescent.

Remarks.—A single specimen of this shell only is before me. My attention was called to it by Dr. Griffith. The beaks are so much worn as to prevent this character from



16 Unio Gouldii.
17 Unio Estabrookianus
18 Unio Blumeri

From Nature on Stone by Prevost

Sinclair's Lith Phila

being obscured, and the whole epidermis is in a bad state. In form it is somewhat allied to *U. obscurus*, (Nobis.) but it cannot be easily confounded with that species, being more compressed, and without rays. The lustre of the nacre is very beautiful.

I name this after A. A. Gould, M. D., of Boston, the able investigator of the Mollusca of Massachusetts.

Unio Estabrookianus. Pl. VI. Fig. 17.

Testâ lævi, triangulari, valdè compressâ: valvulis crassis: natibus prominulis, compressis, ad apices undulatis; epidermide valdè striatâ, luteo-fuscâ, nitidâ; dentibus cardinalibus compressis; lateralibus brevis crassisque; margaritâ albâ et iridescente.

Shell smooth, triangular, much compressed; valves thick; beaks slightly prominent, compressed and undulated at the tips; epidermis much striated, yellowish-brown and shining; cardinal teeth compressed; lateral teeth short and thick; nacre white and iridescent.

Hab. Clinch River and Second Creek, Tennessee. President Estabrook.

My cabinet and cabinet of Mr. Estabrook.

Diam. .1, Length 2.2, Breadth 3.1 inches.

Shell smooth, triangular, much compressed, nearly equilateral; substance of the shell thick before, thinner behind; beaks slightly prominent, compressed, minutely undulate at the tips; ligament rather short and thick; epidermis coarsely striated over the whole disk, shining and rayless, the marks of growth being distant and regular; cardinal teeth rather large, compressed and double in both valves; lateral teeth short and thick, widely separate from the cardinal tooth, and in the direction of the apex; anterior cicatrices distinct; posterior cicatrices distinct; dorsal cicatrices placed under the plate near the cardinal tooth; cavity of the shell very shallow; cavity of the beaks very shallow and rounded; nacre very white and iridescent.

Remarks.—I dedicate this interesting species to President Estabrook, of Knoxville, Tennessee, to whom I am indebted for a fine suite of species, and many other favours. It is more nearly allied to *U. rubiginosus*, (Nobis.) than to any other species, but differs in the coarse striæ and peculiar surface, which gives it the appearance of being varnished. In the young, the epidermis has the yellow colour of *U. Æsopus*, Green,—in the mature specimen it acquires almost a reddish-brown. The sides are remarkably flattened, and the posterior margin is disposed to be biangular.

Unio Binneyi. Pl. VI. Fig. 18.

Testâ lævi, ellipticâ, valdè compressâ, striatâ: valvulis subtenuibus: natibus prominulis; epidermide tenebroso-fuscâ, nitidâ; dentibus cardinalibus parvis, compressis: lateralibus perlongis subcurvisque: margaritâ cæruleo-albâ et iridescente.

Shell smooth, elliptical, much compressed, striated; valves rather thin; beaks slightly prominent; epidermis dark-brown, shining; cardinal teeth small, compressed; lateral teeth very long and rather curved; nacre bluish-white and iridescent.

Hab. Southern States. R. E. Griffith, M. D.

Cabinet of Dr. Griffith.

Diam. .6, Length 1.2, Breadth 2.1 inches.

Shell smooth, elliptical, much compressed, striated, very inequilateral, rounded before and subbiangular behind, flattened anteriorly to the umbonial slope; substance of the shell rather thin; beaks slightly prominent; ligament rather short and very thin; epidermis dark-brown—almost black, without rays, shining, with distinct marks of growth; cardinal teeth small, compressed, double in both valves; lateral teeth very long, thin, lamellar and rather curved; anterior cicatrices confluent, posterior cicatrices confluent; dorsal cicatrices placed nearly in the centre of the cavity of the beaks; cavity of the shell very shallow; cavity of the beaks very shallow; nacre bluish-white and iridescent.

Remarks.—Dr. Griffith called my attention to a single specimen of this shell in his cabinet. The locality is uncertain, except that it is from some one of the southern states —he thinks Alabama. In general form it resembles a very short, compressed *nasulus*, Say. Like it it is flattened posteriorly, but it differs in its epidermis, and in the form of the cardinal teeth. The umbonial slope is slightly biangular. It has somewhat the aspect of *U. multistriatus*, (Nobis,) but it is a thinner shell. The beaks being eroded, the characters could not be ascertained—but they have the aspect of some of the species from South America.

I name this after Amos Binney, M. D., of Boston, a gentleman who has devoted much time to the development of our terrestrial Mollusca.

Unio fuliginosus. Pl. VII. Fig. 19.

Testâ lævi, transversâ, subcompressâ; valvulis suberassis; natibus prominulis: epidermide tenebroso-fusca: dentibus cardinalibus parvis; lateralibus longis curvisque; margaritâ vel albâ vel purpureâ.

Shell smooth, transverse, rather compressed; valves rather thick; beaks slightly prominent; epidermis dark-brown; cardinal teeth small; lateral teeth long and curved; nacre white or purple.

Hab. Cobb's Creek, near Philadelphia. R. E. Griffith, M. D.

My cabinet and cabinet of Dr. Griffith.

Diam. .7, Length 1.1, Breadth 2.2 inches.

Shell smooth, transverse, rather compressed, subangular behind, carinate on the posterior dorsal margin; substance of the shell rather thick; beaks slightly prominent; ligament rather long and thin; epidermis dark-brown, smooth, somewhat polished, without rays, with distant distinct lines of growth; cardinal teeth small, pointed, single in the right and double in the left valve; lateral teeth long, curved upward, and thickened at the posterior end; anterior cicatrices distinct; posterior cicatrices distinct; dorsal cicatrices placed nearly in the centre of the cavity of the beaks; cavity of the shell rather shallow and rounded; cavity of the beaks shallow and somewhat angular; nacre white or purple.

Remarks.—It must be considered as quite a remarkable circumstance that a new species of *Unio* should have remained unobserved in the vicinity of Philadelphia, where so many zoologists have been, within the last thirty years, employed in researches. The first individual captured by Dr. Griffith was obtained about six months since, in Cobb's Creek, near La Grange, the country seat of Manuel Eyre, Esq. Subsequently Dr. Griffith found three more specimens, of different ages. All these are before me, and certainly present characters distinct from any species known to that accurate and experienced

naturalist, Dr. Griffith, or myself. By an inexperienced eye it might be considered as an aberrant form of *U. complanatus*, but in outline it is really more like *Margaritana margaritifera*. It differs from *complanatus* in being more transverse, in being without rays, in the remarkable lines of growth, and in its teeth. The lateral tooth enlarges suddenly from the small plate near the cardinal tooth and curves upwards; in the left valve the inferior portion of the lateral tooth is very much thickened. Two of the specimens before me are perfectly white—one is tinged with purple on the posterior portion—the fourth is purple over the whole nacre.

Unio Pallescens. Pl. VII. Fig. 20.

Testâ lævi, elliptică, valdè inflatâ; valvulis subcrassis; natibus subprominentibus; epidermide pallido-luteâ; dentibus cardinalibus magnis, compressis erectisque; lateralibus longis curvisque; margarita albâ.

Shell smooth, elliptical, much inflated; valves rather thick; beaks slightly prominent; epidermis pale-yellow; cardinal teeth large, compressed and erect; lateral teeth long and curved; nacre white.

Hab. Tuscaloosa, Alabama. B. W. Budd, M. D.

Cabinet of Dr. Budd.

Diam. 1.4, Length .2, Breadth 3.1 inches.

Shell smooth, elliptical, much inflated: substance of the shell rather thick; beaks slightly prominent; ligament long and large; epidermis pale-yellow colour, striate and somewhat shining, apparently without rays; cardinal teeth large, compressed, elevated, pointed and double in both valves; lateral teeth long, lamellar, and curved; anterior cicatrices distinct; posterior cicatrices distinct; dorsal cicatrices placed across the cavity of the beaks; cavity of the shell deep and large; cavity of the beaks small and rounded; nacre silvery-white and iridescent.

Remarks.—A single and not very perfect specimen of this species is before me. It seems to be allied, on one side, to *U. lutcolus*, Lam., and, on the other, to *U. stramineus*, Conrad. A large portion of the disks being eroded from the beaks downwards, the characters of the younger growths cannot be observed. Its teeth are very much like those of *lutcolus*, but I do not think this specimen could, with propriety be considered to belong to that species.

Unio caliginosus. Pl. VII. Fig. 21.

Testa lævi, elliptică, subcompressâ; valvulis subtenuibus; natibus prominulis, ad apicem undulatis; epidermide tenebroso-fuscâ; dentibus cardinalibus compressis, elevatis; lateralibus longis subcurvisque; margarita albâ et iridescente.

Shell smooth, elliptical, rather compressed; valves rather thin; beaks somewhat prominent, undulated at the beaks; epidermis dark-brown; cardinal teeth compressed, elevated; lateral teeth long and somewhat curved; nacre white and iridescent.

Hab. Red River, at Alexandria, Louisiana. J. Hale, M. D.

My cabinet and cabinet of Dr. Hale.

Diam. .8, Length 1.2, Breadth 2.2 inches.

Shell smooth, elliptical, rather compressed, obtusely angular behind; substance of the shell rather thin, slightly thickened before; beaks somewhat prominent and minutely un-

dulated at the tip; ligament rather long and thin; epidermis very dark-brown, somewhat wrinkled, and scarcely showing the lines of growth; cardinal teeth compressed, single in the right and double in the left valve, elevated, slightly crenulate, the anterior being the most elevated; lateral teeth long and somewhat curved; anterior cicatrix distinct; posterior cicatrix confluent; dorsal cicatrices placed in the centre of the cavity of the beaks; cavity of the shell rather shallow; cavity of the beaks shallow and angular; nacre white and iridescent.

Remarks.—Five female and three male adults, with two young shells of this species were received from Dr. Hale, at different times. The females are a good deal enlarged over the posterior slope, and spread out on the posterior basal margin. It seems to be nearly allied to *Nashvillianus*, Nobis, and to *Haleianus*, Nobis. It is not so large or pearly a nacre as the latter, nor does it seem to grow quite so large as the former. In the beaks it also differs from it. In some of the old specimens indistinct rays may be observed through the very dark surface. In the two young shells rays may be observed on the whole disk. The undulations of the beaks are small and very closely set.

Unio spatulatus. Pl. VIII. Fig. 22.

Testâ lævi, ellipticâ, compressâ; valvulis subtenuibus; natibus vix prominulis, ad apicem undulatis; epidermide luteâ, valdè radiatâ; dentibus cardinalibus parvis; lateralibus longis rectisque; margaritâ albâ et iridescente.

Shell smooth, elliptical, compressed; valves rather thin; beaks slightly prominent and undulated at the beak; epidermis yellowish, with numerous rays; cardinal teeth small; lateral teeth long and straight; nacre white and iridescent.

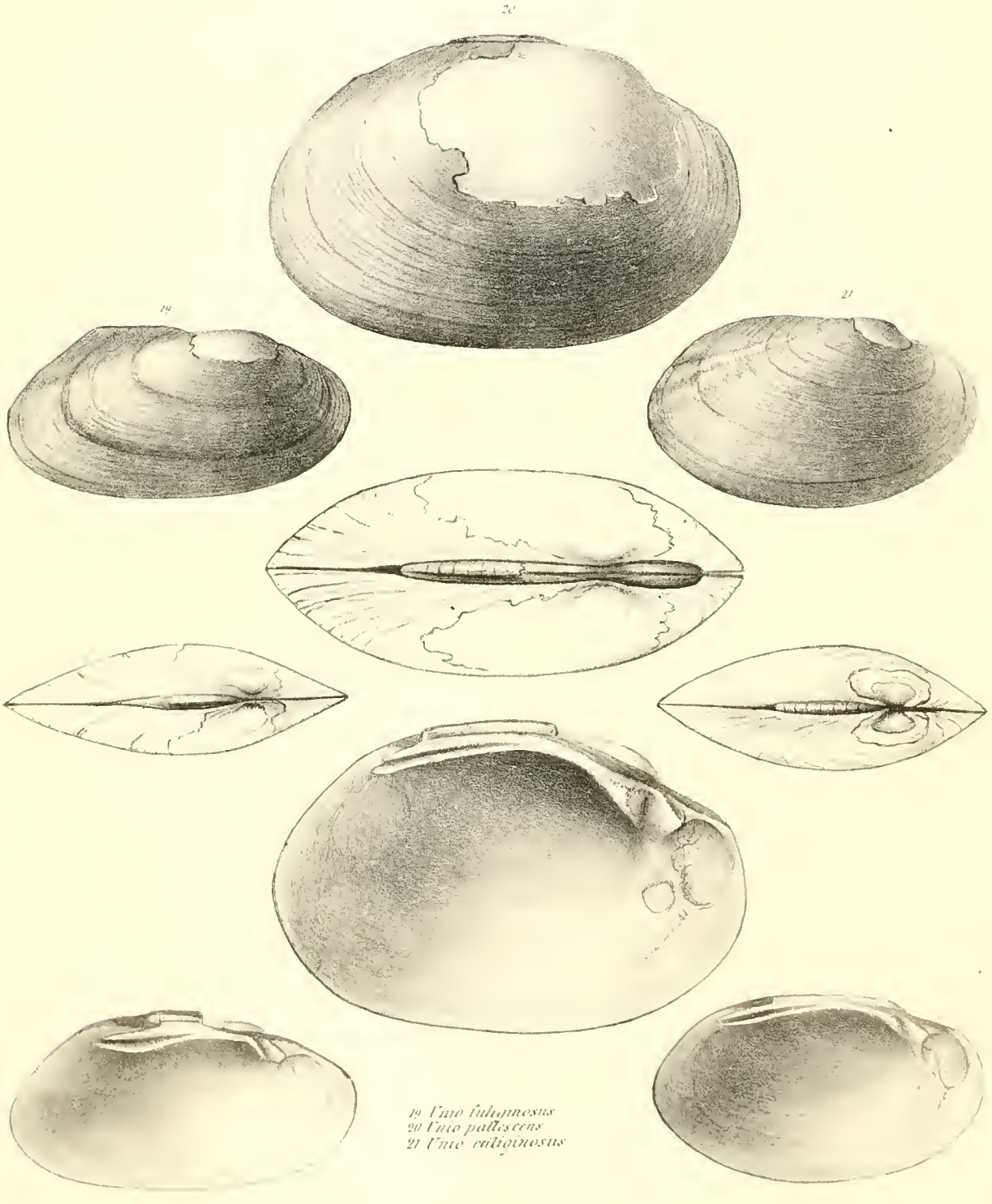
Hab. Rock River, Wisconsin. Captain Maryatt and B. W. Budd, M. D.

My cabinet and cabinet of Dr. Budd.

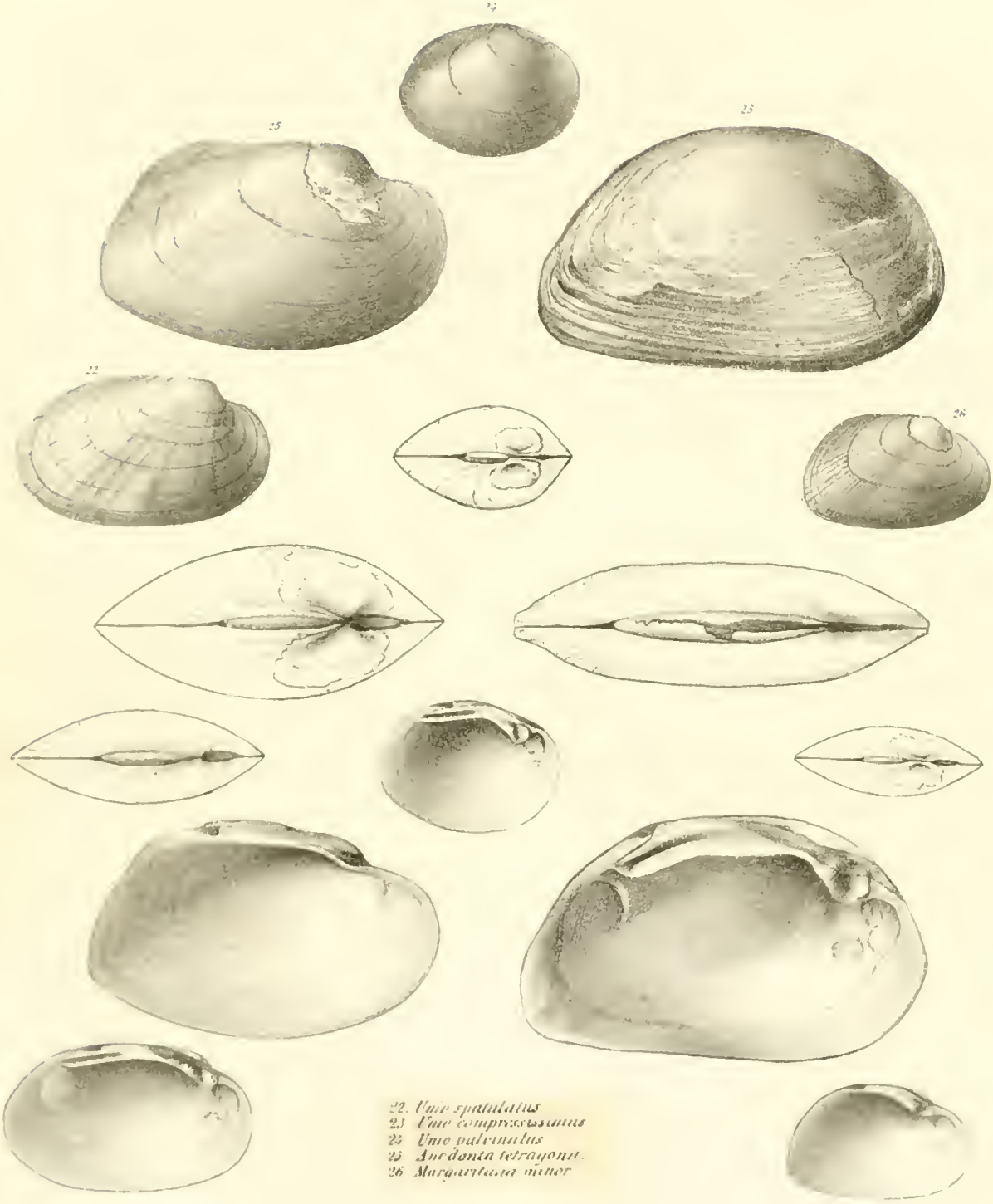
Diam. .6, Length .9, Breadth 1.5 inches.

Shell smooth, elliptical, compressed, very inequilateral; substance of the shell rather thin; beaks but slightly prominent and minutely undulate at the tips; ligament long and thin; epidermis yellowish, with numerous green rays nearly over the whole disk; cardinal teeth very small and pointed, double in the left and single in the right valve; lateral teeth long and straight; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed in the centre of the cavity of the beaks; cavity of the shell shallow; cavity of the beaks shallow and angular; nacre white.

Remarks.—Many years since Captain Maryatt sent me a box of shells from Wisconsin, in which there was a single imperfect specimen of this species. Although pretty well convinced that it was new and undescribed, I delayed inserting it in my former paper, in the hope of getting better specimens. Dr. Budd has submitted to my examination two perfect specimens, neither being eroded even on the beaks, which are finely undulated. It has some resemblance to *U. iris*, Nobis, but is a shorter and a more ponderous shell. It also bears some resemblance to the young of *U. crassus*, Say, and to *U. ellipsiformis*, Conrad, but differs from the latter in the form of the cardinal tooth, and in the beaks, which Mr. Conrad describes as *simple*, while in the *spatulatus* they are *undulate*.



19 *Unio fuliginosus*
20 *Unio pallescens*
21 *Unio caliginosus*



22. *Unio spatulatus*
23. *Unio compressissimus*
24. *Unio pulvinulus*
25. *Anodonta tetragona.*
26. *Margaritana minor*

Unio compressissimus. Pl. VIII. Fig. 23.

Testa lævi, subtriangulari, valdè compressâ; valvulis crassis; natibus compressis; dentibus cardinalibus parvis, crenulatis; lateralibus magnis, crassis curvisque; margaritâ albâ.

Shell smooth, subtriangular, very much compressed; valves thick; beaks compressed; cardinal teeth very small, crenulate; lateral teeth large, thick, and curved: nacre white.

Hab. Holston River, Tennessee. President Estabrook.

My cabinet and cabinets of Mr. Estabrook and Dr. Griffith.

Diam. .8. Length 1.6, Breadth 2.6 inches.

Shell smooth, subtriangular, very much compressed, sub-arcuate at base, and angular behind; substance of the shell very thick, very irregular on the interior surface, thick before and thinner behind; beaks very much compressed and slightly prominent; ligament long and large; cardinal teeth very remarkably small, crenulate, single in the right and double in the left valve; lateral teeth very large, thick, and curved; anterior cicatrices distinct; posterior cicatrices distinct; dorsal cicatrices placed along the edge of the plain over the cavity of the beaks; cavity of the shell exceedingly shallow; cavity of the beaks very shallow and subangular; nacre white.

Remarks.—This is a very remarkable species, being more compressed than any *Unio* which has come under my notice. Both the specimens before me are unfortunately without any epidermis, except along the basal margin, and there too much injured to display any character. Although so completely eroded over the whole exterior surface, they were taken alive, and the interior is fresh. The cavity of the shell being very small, the included soft parts must have been unusually small. The interior aspect of the shell is peculiar, the surface of the nacre being very irregular, almost varicose. In each of the four valves before me there is an impressed line running from the inner side of the great posterior cicatrix up to the cavity of the beak. The form, in younger and more perfect specimens, will, I presume, be found to be more elliptical. It is likely that this species prefers a gravelly bottom and rapid current. It is most nearly allied to *U. phaseolus*, Hild.

Unio pulvinulus. Pl. VIII. Fig. 24.

Testâ lævi, ellipticâ, inflatâ; valvulis crassis; natibus prominentibus; epidermide tenebroso-fuscâ; dentibus cardinalibus minutissimis; lateralibus brevis rectisque; margaritâ albâ et iridescente.

Shell smooth, elliptical, inflated; valves thick; beaks prominent; epidermis dark-brown; cardinal teeth very small; lateral teeth short and straight; nacre white and iridescent.

Hab. Tuscaloosa and Coosawattee River, Murray County, Alab. B. W. Budd, M. D.

My cabinet and cabinets of Dr. Budd and Dr. Griffith.

Diam. .6. Length .9, Breadth 1.2 inches.

Shell smooth, elliptical, inflated, obtusely angular on the umbonial slope and slightly flattened on the sides, inequilateral; substance of the shell thick before and thin behind; beaks rather prominent and full; ligament very short and thin; epidermis dark-brown, smooth, shining and without rays; cardinal teeth very small, erect and pointed, single in the right and double in the left valve; lateral teeth short and straight; anterior cicatrices

confluent; posterior cicatrices distinct; dorsal cicatrices placed on the under side of the plate near the cardinal tooth; cavity of the shell deep and rounded; cavity of the beaks very shallow and rounded; nacre pearly white and very iridescent.

Remarks.—A single specimen only of this small species was procured by Dr. Budd. It is nearly allied to *U. castaneus*, Nobis, but may be easily distinguished from it by its not being oblique, and in having the umbonial slope angular. The cardinal teeth are also very much smaller.

Anodonta tetragona. Pl. VIII. Fig. 25.

Testâ lævi, oblongâ, valdè inflatâ; valvulis tenuibus; natibus prominulis; epidermide luteo-fuscâ, radiatâ; margaritâ cæruleo-albâ et iridescente.

Shell smooth, oblong, much inflated; valves thin; beaks somewhat prominent; epidermis yellowish-brown, rayed; nacre bluish-white and iridescent.

Hab. Alexandria, Louisiana. J. Hale, M. D.

My cabinet and cabinet of Dr. Hale.

Diam. 1.00, Length 1.4, Breadth 2.2 inches.

Shell smooth, oblong, very much inflated, subangular on the umbonial slope, inequilateral, incurved on the dorsal margin, angular behind; substance of the shell very thin; beaks somewhat prominent; ligament rather long and thin; epidermis yellowish-brown, with numerous indistinct rays; anterior cicatrices confluent; posterior cicatrices confluent; dorsal cicatrices immediately over the centre of the cavity of the beaks; cavity of the shell deep and rounded; cavity of the beak rather deep and angular; nacre bluish-white.

Remarks.—Among the shells sent to me by Dr. Hale, was a single specimen of this species, which, though nearly allied to Mr. Say's *edentula*, may be easily distinguished by its angular umbonial slope. The rudiments of a cardinal tooth are quite as prominent, if not more so, than in the *edentula*, which, when described by Mr. Say, he considered to belong to his genus *Alasmodonta*. The lines of growth in *tetragona* are distinct and distant, and the basal margin in the interior is somewhat rubiginose.

Margaritana minor. Pl. VIII. Fig. 26.

Testâ lævi, triangulari, compressâ; valvulis tenuibus; natibus prominulis, ad apices undulatis; epidermide viridi-luteâ; dentibus cardinalibus parvis; margaritâ cæruleo-albâ et iridescente.

Shell smooth, triangular, compressed; valves thin; beaks slightly prominent, undulated at the beaks; cardinal teeth small; nacre bluish-white and iridescent.

Hab. Tennessee—S. M. Edgar, M. D. North Carolina—B. W. Budd, M. D.

Diam. .5, Length .7, Breadth 1.2 inches.

Shell smooth, triangular, compressed, obtusely angular on the umbonial slope and flattened on the side, inequilateral; substance of the shell very thin and somewhat transparent, thicker before than behind; beaks slightly prominent and minutely undulate at the tips; ligament very short and very thin; epidermis greenish-yellow, greener on the posterior portion, with minute striæ; cardinal teeth very small and somewhat pointed;

anterior cicatrices confluent; posterior cicatrices confluent; dorsal cicatrices placed nearly in the centre of the cavity of the beaks; cavity of the shell very shallow; cavity of the beaks rather shallow and angular; nacre bluish-white and iridescent.

Remarks.—A single specimen of this shell was sent to me many years since, by Dr. Edgar, with many other species. As it was, however, evidently not a mature shell, I hesitated about describing it, although I was well convinced of its being new. Two specimens submitted to me by Dr. Budd, proved to be unquestionably the same, and one, which seems to be mature, has answered for this description. They are no doubt from that part of North Carolina where the streams flow into the Tennessee River.

This species is a very small one, and is allied to *M. deltoidea*, Nobis, but it is a thinner, lighter shell, and smaller. Two of the specimens before me have the posterior portion of the shell greenish, which colour is caused by minute, indistinct rays, which can be distinguished by close examination.

Melania solida. Pl. IX. Fig. 27.

Testa lævi, obtuso-conicâ, crassâ, solidâ, tenebroso-corneâ: spirâ subbrevi: suturis valdè impressis: anfractibus convexis: aperturâ parvâ, rhomboideâ, ad basim contortâ, intus albâ; columellâ inflectâ.

Shell smooth, obtusely conical, thick, solid, dark horn-colour; spire rather short; sutures much impressed; whorls convex: aperture small, rhomboidal, twisted at the base, white within; columella inflected.

Hab. Tennessee. E. Foreman, M. D.

My cabinet and cabinet of Dr. Foreman.

Diam. .5. Length .9 of an inch.

Remarks.—This species in form somewhat resembles *M. alveare*, Con., on one side, and *M. canaliculata*, Say, on the other. It has not, however, either furrows or tubercles. The three specimens before me have all mutilated apices, and therefore the number of whorls cannot be correctly ascertained. There may be seven or eight. The aperture is about one-third the length of the shell. There is no appearance of bands in these. This is one of those species which have a twisted aperture, being auger-shaped, the outer lip being spread out, and the edge having a line of double curvature. The columella is very much twisted.

Melania Proteus. Pl. IX. Fig. 28.

Testâ lævi, subcylindraceâ, crassâ, pupæforme, luteo-corneâ: spirâ elevatâ: suturis impressis: anfractibus septenis, subconvexis; aperturâ parvâ, rhomboideâ, ad basim angulatâ, intus albidâ.

Shell smooth, subcylindrical, thick, pupæform, yellowish horn-colour; spire elevated; sutures impressed; aperture small, rhomboidal, angular at the base, within whitish.

Hab. Tuscaloosa, Alabama. B. W. Budd, M. D.

My cabinet and cabinet of Dr. Budd.

Diam. .5. Length 1 inch.

Remarks.—There were six specimens submitted to me by Dr. Budd, which I refer to the one species, although they present considerable difference. Five of the specimens are dead and bleached shells, and are of a light yellow or buff colour. The sixth is a fresh

and perfect specimen, with four small purple bands and a tuberculous shoulder, the tubercles being prolonged nearly into folds. Two others are indistinctly banded. Another has a tuberculous shoulder, and is disposed to be granulate. From these varieties arises the name given to it. The aperture is rather contracted, and about two-fifths the length of the shell.

Melania lugubris. Pl. IX. Fig. 29.

Testâ lævi, subacuto-conoideâ, subcrassâ, tenebroso-fuseâ; spirâ subelevatâ; suturis latè impressis; anfractibus planulatis: aperturâ parvâ, rhomboideâ, intus cæruleâ, infernè angulatâ.

Shell smooth, rather acutely conical, rather thick, dark-brown; spire rather elevated; sutures widely impressed; whorls flattened; aperture small, rhomboidal, within bluish, angular below.

Hab. Alabama. Major Le Conte.

Cabinet of Major Le Conte.

Diam. .37, Length .85 of an inch.

Remarks.—A single specimen only of this species was received by Major Le Conte. There are no strong characters to separate it, but it is certainly different from any with which I am acquainted. Like the *canaliculata*, Say, it is auger-shaped on the right lip, but it is a much smaller shell, and without the sulcations of that species. There is an angle in the middle of the whorl which causes the sutures to be rather wide and marked. The apex being eroded, the number of whorls cannot be ascertained—probably eight. The aperture is about one-third the length of the shell.

Melania torta. Pl. IX. Fig. 30.

Testâ lævi, claviformi, subcrassâ, tenebroso-fuscâ; spirâ obtusâ; suturis impressis; anfractibus convexis; aperturâ grande, elliptieâ: columellâ tortâ.

Shell smooth, club-shaped, rather thick, dark-brown; spire obtuse; sutures impressed; whorls convex; aperture large, elliptical; columella twisted.

Hab. Big Creek, Laurence County, Tennessee. J. Clark.

My cabinet and cabinets of J. Clark and T. G. Lea.

Diam. .36, Length .73 of an inch.

Remarks.—There were eight specimens of this species submitted to my examination by Mr. Clark, of Cincinnati. In general outline and size it very closely resembles *M. Warderiana*, (Nobis,) but differs from the specimens of that species which have come under my notice, in not being carinate, and in having a more twisted columella. The apices of the individuals now before me are slightly eroded, and the number of whorls may be seven or eight. One of the specimens has small folds near the apex, with decussating striæ. The inside is bluish-white—one of the specimens having a brown mark at the columella. The aperture is nearly one-half the length of the shell. Over the whole surface there are small, irregular ridges. The body whorl is very long.

Melania spurca. Pl. IX. Fig. 31.

Testâ lævi, pyramidatâ, subcrassâ, tenebroso-fuscâ; spirâ subelevatâ; suturis subimpressis; anfractibus octonis, planulatis; aperturâ parvâ, rhomboideâ, ad basim angulatâ, intus albidâ.

Shell smooth, pyramidal, somewhat thick, dark-brown; spire somewhat elevated; sutures slightly impressed; whorls eight, flattened; aperture small, rhomboidal, angular at the base, within white.

Hab. Alabama. Major Le Conte.

Cabinet of Major Le Conte.

Diam. .43, Length .98 of an inch.

Remarks.—This species, of which only a single one was received by Major Le Conte, has no striking character, but cannot be placed with any other with which I am acquainted. It is very regular in its form, with a patulous, auger-shaped, outer lip, the margin of which is quite sinuous. The aperture is nearly one-third the length of the shell. It more nearly resembles *M. regularis*, (Nobis,) than any other species, but is not so large or solid a shell.

Melania abrupta. Pl. IX. Fig. 32.

Testâ lævi, abbreviato-conoideâ, subcrassâ, luteâ; spirâ abbreviatâ; suturis lineatibus; anfractibus septenis, planulatis; aperturâ magnâ, ovatâ, intus albidâ.

Shell smooth, short-conical, rather thick, yellowish; spire very short; sutures linear; whorls seven, flattened; aperture large, ovate, within whitish.

Hab. Alabama. Major Le Conte.

My cabinet and cabinet of Major Le Conte.

Diam. .3, Length .64 of an inch.

Remarks.—This species in size and form is somewhat allied to *M. Nickliniana*, (Nobis,) but has the spire more elevated, and is not reddish. The two specimens before me have each two purple bands. This character may be frequent without being constant. The aperture is nearly half the length of the shell.

Melania basalis. Pl. IX. Fig. 33.

Testâ lævi, ellipticâ, subcrassâ, luteo-viridi, fasciatâ; spirâ curtâ, obtusâ; suturis impressis; anfractibus convexis; aperturâ ovato-elongatâ, ad basim acuto-angulatâ, intus albidâ.

Shell smooth, elliptical, rather thick, yellowish-green, banded; spire short, obtuse; sutures impressed; whorls convex; aperture ovately elongate, at the base acutely angular, within whitish.

Hab. Alabama. Major Le Conte.

My cabinet and cabinet of Major Le Conte.

Diam. .43, Length .83 of an inch.

Remarks.—The elliptical form of this species is very remarkable. The spire is very short and obtuse. The apex of each of the two specimens before me is eroded, two whorls only being perfect. It has numerous purple bands, and the aperture is rather more than half the length of the shell. The base of the shell is extended and slightly retuse. One of the specimens, near to the superior part of the whorl, is disposed to swell into large tubercles. The epidermis is very smooth and polished.

Melania modesta. Pl. IX. Fig. 34.

Testâ lævi, conoideâ, subfusiformi, subtenui, nigrâ; spirâ subelevatâ; suturis linearibus; anfractibus planulatis, ultimo in medio angulato; aperturâ elliptieâ, subgrandi, intus tenebrosâ.

Shell smooth, conical, somewhat fusiform, rather thin, black; spire rather elevated; sutures linear; whorls flattened, the last angular in the middle; aperture elliptical, rather large, within dark.

Hab. Chatahoochee River, at Columbus, Georgia. S. Boykin, M. D.

My cabinet.

Diam. .28, Length .67 of an inch.

Remarks.—A single specimen of this species came from Dr. Boykin, with some others, which I published some years since. This one was deferred in the hopes of getting more for comparison. In outline and colour it is very closely allied to a shell I described, from Tennessee, under the name of *tenebrosa*. It differs from it in having the aperture less distended, in having an angle on the middle of the whorl, and in being more fusiform. The apex being eroded, the number of whorls cannot be ascertained—there are about seven. The aperture is nearly one-half the length of the shell. The bands are so broad and dark as to give, in this specimen, a black appearance to the whole shell, except at the termination of the whorl, where the outer lip is yellow.

Melania Haleiana. Pl. IX. Fig. 35.

Testâ lævi, acuto-conoideâ, subtenui, lutco-corneâ, politâ; spirâ elevatâ; suturis impressis; anfractibus novenis, convexis; aperturâ parvâ, ovatâ, ad basim subangulatâ, intus albidâ.

Shell smooth, acutely conical, rather thin, yellowish horn-colour, polished; spire elevated; sutures impressed: whorls nine, convex; aperture small, ovate, at the base angular, within whitish.

Hab. Alexandria, Louisiana. J. Hale, M. D.

My cabinet and cabinet of Dr. Hale.

Diam. .17, Length .64 of an inch.

Remarks.—Among some fifty specimens of small *Melaniæ* sent by Dr. Hale, I found three species, nearly the whole, however, being of the above described. It has no very distinctive character, but cannot be placed with any species with which I am acquainted. It resembles some of the young varieties of *M. Virginica*, Say, but has the whorls more convex, and the aperture smaller. Four or five specimens are banded, and these have uniformly two bands, the inferior one being larger and much more distinctly marked. The first few whorls of the apex are carinate. The aperture is about one-fourth the length of the shell.

Melania pumila. Pl. IX. Fig. 36.

Testa lævi, obtuso-conoideâ, subcrassâ, tenebroso-corneâ; spirâ depressâ: suturis valdè impressis; anfractis subconvexis; aperturâ elongatâ, contractâ, ad basim contortâ, intus albidâ.

Shell smooth, obtusely conical; rather thick, dark horn-colour; spire depressed; sutures much impressed; whorls slightly convex; aperture elongate, contracted, twisted at the base, within whitish.

Hab. Tuscaloosa, Alabama. B. W. Budd, M. D.

My cabinet and cabinet of Dr. Budd.

Diam. .27, Length .53 of an inch.

Remarks.—The two specimens before me are, in form and size, the same. They differ in one having two broad, purple bands, and the other being entirely without. On the inferior part of the whorl one has five rather distinct striæ, the other has these less distinct. The apex of each of these is eroded, and therefore the number of the whorls cannot be ascertained. This species is closely allied to *M. alveare*, Conrad, but is a much smaller shell, and in the two individuals before me there is no appearance of the tubercles which usually exist on the carina of the lower whorl of that species.

Melania Alexandrensis. Pl. IX. Fig. 37.

Testâ lævi, subacuto-conoideâ, subtenui, tenebroso-corneâ; spirâ subelevatâ; suturis subimpressis; anfractibus subplanulatis; apertura parva, subtrapezoideâ, intus albidâ.

Shell smooth, rather acutely conical, rather thin, dark horn-colour; spire rather elevated; sutures somewhat impressed; whorls rather flattened; aperture small and somewhat trapezoidal; within whitish.

Hab. Alexandria, Louisiana. J. Hale, M. D.

My cabinet and cabinet of Dr. Hale.

Diam. .22, Length .58 of an inch.

Remarks.—There were two only of this species which came from Dr. Hale. It closely resembles the *Halciana*, herein described, but has a less elevated spire, and the aperture differs, in being somewhat auger-shaped, the outer lip being more sinuous. The apex of each being broken, the number of whorls cannot be ascertained. The aperture is rather more than a fourth of the length of the shell.

Melania ovoidea. Pl. IX. Fig. 38.

Testâ lævi, ellipticâ, subcrassâ, corneâ: spirâ brevi; suturis vix impressis; anfractibus senis, subconveris; aperturâ magnâ, subovatâ, intus albida.

Shell smooth, elliptical, rather thick, horn-colour; spire short; sutures slightly impressed; whorls six, slightly convex; aperture large, nearly ovate, within white.

Hab. Alexandria, Louisiana. J. Hale, M. D.

My cabinet and cabinet of Dr. Hale.

Diam. .2, Length .44 of an inch.

Remarks.—A single specimen only of this little species was found among the shells sent by Dr. Hale. It differs entirely from the other two species, and approaches Mr. Say's *depygis*, but is smaller, and has a proportionately larger aperture. The aperture is quite one-half the length of the shell. The columella is somewhat thickened on the superior portion. In the specimen before me there are two broad, rather indistinct brown bands.

Melania auriculæformis. Pl. IX. Fig. 39.

Testâ lævi, ellipticâ, subtenui, lutcâ; spirâ depressa; suturis impressis; anfractibus senis, subconvexis; aperturâ elongatâ, contractâ, ad basim rotundatâ, intus albidâ.

Shell smooth, elliptical, rather thin, yellow; spire depressed; sutures impressed; whorls six, slightly convex; aperture elongate, contracted, at the base rounded, within whitish.

Hab. Tuscaloosa, Alabama. B. W. Budd, M. D.

Cabinet of Dr. Budd.

Diam. .24, Length .45 of an inch.

Remarks.—This species has very much the aspect of an *Auricula*. It is a very regularly formed and pretty shell, with a smooth, yellow, polished, epidermis. The aperture is about two-thirds the length of the shell, regularly rounded below and angular above, where there is a good deal of nacreous matter deposited.

Melania carino-costata. Pl. IX. Fig. 40.

Testâ plicatâ, carinatâ, conoideâ, subtenui, vel lutcâ vel castaneâ; spirâ subelevatâ; suturis sulcatis; anfractibus planulatis; aperturâ parvâ, ellipticâ; columellâ lævi.

Shell plicate, carinate, conical, rather thin, yellow or chestnut-coloured; spire somewhat elevated; sutures sulcate; whorls flattened; aperture small, elliptical; columella smooth.

Hab. Alabama—Major Le Conte. Tennessee—B. W. Budd, M. D.

My cabinet and cabinets of Major Le Conte and Dr. Budd.

Diam. .36, Length .98 of an inch.

Remarks.—This is a species not easily confounded with any other known to me. The character of the ribs or folds is peculiar; they being arrested near the sutures by an abrupt carina, which has a smaller parallel one between it. The folds and the carinæ are conspicuous, being perfectly pronounced. Two of the six specimens before me are of a dark chestnut-brown, with the nacre of the interior quite rufous. One is more horn-coloured, having four bands, and the nacre whitish. The three others, all from Dr. Budd, are wax-yellow, the ribs less expressed, and the interior yellowish. The apex of each being broken, the number of whorls cannot be determined—I should think there were about eight. The inferior part of the whorl is smooth. The aperture is rather more than one-third the length of the shell.

Melania filum. Pl. IX. Fig. 41.

Testâ carinatâ, conoideâ, subtenui, tenebroso-corneâ; spirâ elevatâ; suturis impressis; anfractibus planulatis, in medio carinatis; aperturâ parvâ, rhomboideâ, ad basim angulatâ, intus albidâ; columellâ tortâ.

Shell carinate, conical, rather thin, dark horn-colour; spire elevated; sutures impressed; whorls flattened, carinate in the middle; aperture small, rhomboidal, angular at the base, within whitish, columella twisted.

Hab. Alabama. Major Le Conte.

Cabinet of Major Le Conte.

Diam. .47. Length 1.06 inches.

Remarks.—A single specimen only of this species was submitted to me by Major Le Conte. It is very nearly allied to *M. elevata*, Say, but may be distinguished by its thread-like carina on the middle of the whorls, which, on the superior ones, presents a mere simple line. The outer lip is remarkably patulous, presenting the auger-shaped lip which belongs to a certain group of the *Melaniæ*. The apex being imperfect, the number of whorls cannot be ascertained. There are eight visible on this specimen, and it probably possesses ten in a perfect state. The aperture is about one-third the length of the shell.

Melania spinalis. Pl. IX. Fig. 42.

Testâ carinatâ, acuto-conoideâ, subtenui, luteâ, bifasciatâ: spirâ elevatâ; suturis exaratis: anfractibus planulatis: aperturâ parvâ, ovatâ, ad basim angulatâ, intus albidâ.

Shell carinate, acutely conical, rather thin, yellow, double-banded; spire elevated; sutures ploughed out; whorls flattened; aperture small, ovate, angular at the base, white within.

Hab. Alabama. Major Le Conte.

Cabinet of Major Le Conte.

Diam. .33, Length .96 of an inch.

Remarks.—A single specimen only was submitted to me, and this not very perfect. It is a peculiar shell in its general appearance. The colour being of an unusually bright yellow, with two broad, distinct bands, one immediately above the middle of the whorl and the other below. The superior part of the whorl is darker than that below. The number of whorls cannot be given, the apex being broken. There were probably nine or ten. The aperture is about one quarter the length of the shell.

Melania pallescens. Pl. IX. Fig. 43.

Testâ carinatâ, subacuto-conoideâ, subtenui, luteâ; spirâ subelevatâ: suturis impressis: anfractibus novenis, subconvexis: aperturâ parvâ, ovatâ, ad basim angulatâ, intus albidâ.

Shell carinate, rather acutely conical, somewhat thin, yellow; spire somewhat elevated; sutures impressed; whorls nine, rather convex: aperture small, ovate, angular at the base, within whitish.

Hab. Chester District, South Carolina. Professor Vanuxem.

My cabinet and cabinets of Professor Vanuxem and Major Le Conte.

Diam. .34, Length .87 of an inch.

Remarks.—Many years since, my friend Professor Vanuxem gave me several specimens of this shell. Until recently, I was not satisfied that it was not merely a variety of *semicarinata*, Say, but I am disposed to think it differs too much to be considered merely a variety. It is a larger shell, with more whorls and more distinct carinations. The colour also differs, in being much lighter. A single specimen was among the shells sent from Major Le Conte, which, I suspect, is from Georgia, the locality not being certain. Those from Professor Vanuxem are from Major Green's farm. The aperture is less than one-third the length of the shell. All the specimens are without bands but one, which has four large, distinct ones.

Melania Buddii. Pl. IX. Fig. 44.

Testâ striatâ, cylindraceâ, subtenui, corneâ; spirâ attenuatâ; suturis impressis; anfractibus planulatis; aperturâ parvâ, ellipticâ, intus albidâ.

Shell striate, cylindrical, rather thin, horn-colour; spire attenuated; sutures impressed; whorls flattened; aperture small, elliptical, within whitish.

Hab. Tennessee? B. W. Budd, M. D.

My cabinet and cabinet of Dr. Budd.

Diam. .32, Length 1.07 inches.

Remarks.—I have two specimens before me, both of which have seventeen revolving striæ on the lower whorl. They have also a single small band immediately below the middle of the body whorl, which is hidden on the superior whorls. Each of the specimens under examination has the apex broken, but I presume the number of whorls may reach to ten. Eight may be counted in one of these. Dr. Budd mentions, in a note, that "out of six, five have a band." The aperture is about one-fourth the length of the shell. This species is nearly allied to the striate variety of Mr. Say's *M. Virginica*, which he called *multistriata*. The *Buddii* may be distinguished by its being flattened on the whorls, in being more angular on the superior part of the whorls, and in being more attenuate.

Melania harpa. Pl. IX. Fig. 45.

Testâ striatâ, conoideâ, subcrassâ, corneâ; spirâ subelevatâ; suturis subimpressis; anfractibus subconvexis; aperturâ parvâ, ellipticâ, ad basim angulatâ, intus albidâ.

Shell striate, conical, rather thick, horn-colour; spire rather elevated; sutures rather impressed; whorls somewhat convex; aperture small, elliptical, angular at the base, within whitish.

Hab. Tuscaloosa, Alabama. B. W. Budd, M. D.

Cabinet of Dr. Budd.

Diam. .42, Length .8 of an inch.

Remarks.—I am not able to place this with any of the species submitted to me by Dr. Budd, and although a single specimen only is under examination, I have considered it new. It has some resemblance to *M. Haysiana*, but is not so cylindrical, and the aperture is not so narrow. It is transversely striate over the whole whorls. The length of the aperture is about two-fifths the length of the shell. The aperture being eroded, the number of whorls cannot be ascertained.

Melania arctata. Pl. IX. Fig. 46.

Testâ striatâ, coarctatâ, crassâ, luteo-corneâ; spirâ conoideâ; suturis valdè impressis; anfractibus senis, planulatis; aperturâ parvâ, rhomboideâ, intus albidâ.

Shell striate, compressed, thick, yellowish horn-colour; spire conical; sutures much impressed; whorls six, flattened; aperture small, rhomboidal, within whitish.

Hab. Tuscaloosa, Alabama. B. W. Budd, M. D.

My cabinet and cabinet of Dr. Budd.

Diam. .10, Length .90 of an inch.

Remarks.—Among the seven specimens before me there is a good deal of difference. Some are darker than others. Several have the superior portion of the whorl rising into a ridge, quite nodose, while others are entirely without it. This species has more resemblance to *M. Haysiana* than any other which has come under my notice. It is not, however, so elliptical a shell, and the aperture is shorter. The aperture of the *arctata* is rather more than one-third the length of the shell; is obtusely angular below, and somewhat acutely angular above, where it is thickened.

Melania crebri-striata. Pl. IX. Fig. 47.

Testâ transversè et crebrissimè striatâ, subfusiformi, crassâ, luteo-corneâ; spirâ obtusâ; suturis impressis; anfractibus subconvexis; aperturâ parvâ, subovatâ, ad basim angulatâ, intus albidâ; columellâ inflectâ supernè incrassatâ.

Shell transversely and very closely striate, nearly fusiform, thick, yellowish horn-colour; spire obtuse; sutures impressed; whorls somewhat convex; aperture small, rather ovate, angular at the base, within whitish; columella inflected and thickened above.

Hab. Tuscaloosa, Alabama. B. W. Budd, M. D.

My cabinet and cabinet of Dr. Budd.

Diam. .40, Length .76 of an inch.

Remarks.—This species is nearly allied to *M. impressa*, (Nobis,) but may be distinguished by its colour being yellowish, and by its coarser striæ. Its aperture also is smaller. The three specimens before me are very differently banded, one having nine, another three, and the last a rather broad one near the upper part of the whorl. These are only seen on the inside. The apex of each being eroded, the number of the whorls could not be accurately counted. Perhaps there are six. The striæ are so strong that they cause the edge of the outer lip to be crenate. The aperture is about two-fifths the length of the shell. On the superior whorls there are broad, slightly elevated, somewhat oblique ribs. The number of striæ on the three specimens before me are, respectively, sixteen, eighteen, and twenty.

Melania nobilis. Pl. IX. Fig. 48.

Testâ tuberculatâ, conoideâ, subcrassâ, luteo-corneâ; spirâ elevatâ: suturis irregulariter undulatis; anfractibus planulatis, in medio tuberculatis; aperturâ subgrandi, productâ, ad basim angulatâ et canaliculatâ, intus luteâ: columellâ tortâ.

Shell tuberculate, conical, rather thick, yellowish horn-colour; spire elevated; sutures irregularly undulate; whorls flattened, in the middle tuberculate; aperture rather large, elongated, angular, and channelled at the base, within yellowish; columella twisted.

Hab. Alabama. Major Le Conte.

Cabinet of Major Le Conte.

Diam. .72, Length 1.7 inches.

Remarks.—This is among the finest of our American species. It is remarkable for its large size and extended sinus, which allies it to the genus *Io*, in which it might, with no great impropriety, be placed. The specimen before me has eight whorls, and the broken

apex would probably present about three more. The central ones have a dark band below, and are of a rather bright horn-colour above. In this specimen there is a rather coarse stria above the row of tubercles, and two smaller ones below. The margin of the outer lip is quite sinuous. It has some resemblance to *M. excurata*, Con., but may be distinguished by having a longer fusc, and in the position of the tubercles, which are not oblique, as described in that shell. When other specimens shall be observed it may be found to differ in some of the characters described above. Aperture rather more than one-third the length of the shell.

Melania pernodosa. Pl. IX. Fig. 49.

Testâ tuberculatâ, conoideâ, suberassâ, corneâ, infernè striatâ: spirâ elevatâ, ad apicem costatâ; suturis undulatis; anfractibus octonis, planulatis, pernodosis; aperturâ parvâ, ad basim angulatâ et canaliculatâ, intus albidâ.

Shell tuberculate, conical, rather thick, horn-colour, striate below; spire elevated, ribbed on the apex; sutures undulated; whorls eight, flattened, tuberculate on the inferior portion; aperture small, angular, and canaliculate at the base, within white.

Hab. Cypress Creek, Florence, Alabama. T. R. Dutton.

My cabinet and cabinet of Mr. Dutton.

Diam. .4, Length .68 of an inch.

Remarks.—This is a very remarkable species, having numerous, somewhat oblique tubercles, thickly set in a single row on the middle of the whorls. In the specimen before me, the only one I have seen, there is a dark spot between each of the tubercles. Towards the apex, the tubercles are more elongate and closely set, so as absolutely to become ribs across the whole of the whorl. The aperture is rather more than one-third the length of the shell. The striæ on the inferior half of the whorls are very regular and distinct, and number eight in this specimen.

Anculosa squalida. Pl. IX. Fig. 50.

Testâ lævi, vel rotundâ vel elliptică, pererassâ, tenebroso-corneâ: spirâ obtusâ; suturis vix impressis; aperturâ magnâ, subrotundâ, intus albidâ; columellâ perassâ.

Shell smooth, rounded or elliptical, very thick, dark horn-colour; spire obtuse; sutures scarcely impressed; aperture small, nearly round, within white; columella very thick.

Hab. Tuscaloosa, Alabama. B. W. Budd, M. D.

My cabinet and cabinet of Dr. Budd.

Diam. .45, Length .77 of an inch.

Remarks.—Dr. Budd submitted five specimens to me, and, as is frequently the case, in this genus, I do not find any two of the five exactly of the same outline. One is nearly round and presents but a single whorl. Another, a younger and more perfect specimen, is somewhat elliptical, and presents five whorls and a mammilate form. A third specimen is quite elliptical, the spire being obtusely conical. It is a very solid species, with a broad, thick columella, and a considerable callus above. All the five are obscurely banded. This species is allied to *A. prærosa*, Say, but differs somewhat in form, and has bands, not spotted lines. In some of the specimens the aperture is nearly the whole length of the shell.

Anculosa tintinnabulum. Pl. IX. Fig. 51.

Testâ lævi, obtuso-conicâ, campanulatâ, fasciatâ, percrassâ, luteâ; spirâ brevi; suturis impressis; anfractibus quinis, impressis; aperturâ rotundâ, subgrandi; columellâ percrassâ, supernè callosâ.

Shell smooth, obtusely conical, bell-shaped, banded, very thick, yellow; spire short; sutures impressed; whorls five, impressed; aperture rather large, round; columella very thick, callous above.

Hab. Tennessee—E. Foreman, M. D. Tuscaloosa, Alabama—B. W. Budd, M. D.

My cabinet and cabinets of Dr. Foreman and Dr. Budd.

Diam. .48, Length .70 of an inch.

Remarks.—The peculiar, constricted lower whorl, giving a campanulate form to this shell, will distinguish it at once from other species. Six specimens before me are all yellow, with broad, brown bands. A single specimen is perfect enough in the spire to make out five whorls. Two of the specimens are white on the columella, and four are tinted with brown. The outline is very remarkable, in its campanulate form. The mouth, in the perfect specimen, is about two-thirds the length of the shell.

Schizostoma* pagoda. Pl. IX. Fig. 52.

Testâ carinatâ, conicâ, subcrassâ, tenebroso-corneâ; spirâ subobtusâ; suturis valdè impressis; anfractibus senis; fissurâ parvâ; aperturâ ellipticâ, intus albidâ; columellâ lævi.

Shell carinate, conical, rather thick, dark horn-colour; spire rather short; sutures very much impressed; whorls six; fissure small; aperture elliptical, within whitish; columella smooth.

Hab. Tuscaloosa, Alabama. B. W. Budd, M. D.

My cabinet and cabinet of Dr. Budd.

Diam. .35, Length .75 of an inch.

Remarks.—Three of this interesting species are before me. They are very distinct, and may easily be known by the carina being very acute on the superior whorls, presenting the appearance of a Chinese pagoda. The lower whorl is slightly and irregularly striate. The fissure is not deep, but rather wide, being about one-fifth the length of the whorl. The columella at the base is rather angular. The aperture is rather more than one-third the length of the shell.

* In a paper read before the society December 16, 1842, I described two species belonging to the *Melanianæ*, with the pleurotomose character of a fissure in the outer lip. For one I proposed the name of *Melania excisa*, the other *Anculosa incisa*, and presuming that the shells bearing this characteristic, so remarkable in a *Melanian*, would require to be placed in a new genus, I then proposed the name of *Schizostoma*. Since then, five or six other species have been observed, and the *genus* may be thus characterized:

Testa vel conica vel fusiformis. Labrum supernè fissurâ. Apertura ovata. Columella lævis, incurva. Operculum . . . . .

No operculum has come under my notice, but I can scarcely doubt that it will be found to be horny, and to resemble, in other respects, that of *Melania*.

Schizostoma Buddii. Pl. IX. Fig. 53.

Testâ striatâ, subfusiformi, crassâ, tenebroso-corneâ; spirâ obtuso-conicâ; suturis irregulariter impressis; anfractibus senis, subinflatis; fissurâ parvâ, obliquâ; aperturâ magnâ, rhomboidcâ, intus albidâ; columellâ supernè callosâ.

Shell striate, subfusiform, thick, dark horn-coloured; spire obtusely conical; sutures irregularly impressed; whorls six, rather inflated; fissure small, oblique; aperture large, rhomboidal, whitish within; columella thickened above.

Hab. Tuscaloosa, Alabama. B. W. Budd, M. D.

My cabinet and cabinet of Dr. Budd.

Diam. .47, Length .83 of an inch.

Remarks.—This is a robust shell, being thicker and heavier than any other species of this genus which I have observed. The aperture is nearly one-half the length of the shell. Two specimens were sent together by Dr. Budd, presuming they were the same. One, however, which is not quite a mature shell, has little or no fissure. The other, from which the description is made, has a wide but short fissure, and the margin of it opens obliquely.

Schizostoma Babylonicum. Pl. IX. Fig. 54.

Testâ striatâ, subfusiformi, subcrassâ, castaneâ; spirâ obtuso-conicâ; suturis impressis; anfractibus planulatis; fissurâ parvâ; aperturâ magnâ, ellipticâ, intus subcarneâ; columellâ lævi, ad basim angulatâ, supernè incrassatâ.

Shell striate, somewhat fusiform, rather thick, chestnut-coloured; spire obtusely conical; sutures impressed; whorls flattened; fissure small; aperture large, elliptical, somewhat flesh-coloured within; columella smooth, angular at the base, thickened above.

Hab. Tuscaloosa, Alabama. B. W. Budd, M. D.

Cabinet of Dr. Budd.

Diam. .48, Length 1 inch.

Remarks.—A single specimen only of this species was submitted to me. It differs from the other described species in being angular at the superior portion of the whorl along the lower margin of the fissure, making quite a shoulder, and giving it the Babylonic appearance. The fissure is wide, but not deep. The apex being much eroded, the number of whorls could not be ascertained. The aperture is nearly half the length of the shell. The deposit on the columella in this individual does not cover the perforation. In others, this may differ. The outer lip is quite patulous.

Schizostoma constrictum. Pl. IX. Fig. 55.

Testâ lævi, subfusiformi, subtenui, luteo-corneâ; spirâ obtusâ; suturis impressis; anfractibus coarctatis; fissurâ submagnâ, subobliquâ; aperturâ magnâ, ellipticâ, intus albidâ; columellâ lævi, ad basim subangulatâ.

Shell smooth, somewhat fusiform, rather thin, yellowish horn-colour; spire obtuse; sutures impressed; whorls constricted; fissure rather large, somewhat oblique; aperture large, elliptical, whitish within; columella smooth, subangular at the base.

Hab. Tuscaloosa, Alabama. B. W. Budd, M. D.

Cabinet of Dr. Budd.

Diam. .43, Length .75 of an inch.

Remarks.—A single specimen only of this species was among the shells submitted to me by Dr. Budd. It differs from those I have seen in having a rather broad channel impressed immediately above the centre of the whorl. This character may, however, differ in other individuals. The fissure is rather wide, but not deep. The apex being eroded, the number of whorls could not be ascertained. The aperture is about one-half the length of the shell. There is no appearance of bands about this specimen.

Schizostoma funiculatum. Pl. IX. Fig. 56.

Testâ striatâ, ellipticâ, subcrassâ, castaneâ; spirâ obtusâ; suturis valdè impressis; anfractibus convexis: fissurâ submagnâ, obliquâ; aperturâ magnâ, ellipticâ; columellâ supernè callosâ.

Shell striate, elliptical, rather thick, chestnut-coloured; spire obtuse; sutures much impressed; whorls convex; fissure rather large, oblique; aperture large, elliptical; columella thickened above.

Hab. Tuscaloosa, Alabama. B. W. Budd, M. D.

Cabinet of Dr. Budd.

Diam. .4, Length .66 of an inch.

Remarks.—A single specimen only was obtained by Dr. Budd of this species. It is short, stout, and almost subrotund. It has two elevated, cord-like lines, revolving on the whorls. One immediately under the suture, the other below that again. The aperture is more than half the length of the shell. The apex is so much eroded as to prevent the number of whorls being ascertained. There are about six.

Schizostoma laciniatum. Pl. IX. Fig. 57.

Testâ lævi, obtuso-conicâ, subcrassâ, fasciatâ, luteo-corneâ; spirâ obtusâ; suturis exaratis; anfractibus convexis; fissurâ profundâ; aperturâ ellipticâ, intus albidâ; columellâ lævi, supernè incrassatâ.

Shell smooth, obtusely conical, rather thick, banded, yellowish horn-colour; spire obtuse; sutures excavated; whorls convex; fissure deep; aperture elliptical, whitish within; columella smooth, thickened above.

Hab. Tuscaloosa, Alabama. B. W. Budd, M. D.

Cabinet of Dr. Budd.

Diam. .25, Length .45 of an inch.

Remarks.—This is the smallest species I have seen. The mouth and fissure of this specimen are perfect, but the apex is much eroded, and the number of whorls cannot therefore be ascertained. There are four bands very distinctly marked on the inside. The aperture appears to be about one-half the length of the shell. The fissure is very narrow and remarkably deep, extending nearly one-fourth round the whorl. The cicatrix along the suture is of a lighter colour. The marks of growth are distinct, and give a laciniate appearance.

PALUDINA HALEIANA. Pl. IX. Fig. 58.

Testâ lævi, ventricoso-conoideâ, subtenui, rufo-cornâ, imperforatâ; spirâ brevi; suturis valdè impressis; anfractibus quaternis, subconvexis; aperturâ magnâ, subrotundâ, cæruleâ.

Shell smooth, ventricosely conical, rather thin, reddish horn-colour, imperforate; spire short; sutures much impressed; whorls four, nearly convex; aperture large, nearly round, bluish.

Hab. Alexandria, Louisiana. J. Hale, M. D.

My cabinet and cabinet of Dr. Hale.

Diam. .4, Length .55 of an inch.

Remarks.—This species is nearly allied to the *P. Troostiana*, (Nobis,) but is rather smaller, of a darker colour, not quite so rotund, and imperforate. These differences would distinguish it without difficulty. In the *Haleiana* there is a disposition in most of the specimens to a compression below the sutures. This makes quite a shoulder at the sutures and prevents the mouth from being regular.

NOTE.—Since the first sheet of this paper was printed off, two more *Melania*, by Dunker, have been added to the list, making in all three hundred and ninety-seven.

CATALOGUE OF THE GENUS MELANIA,

RECENT AND FOSSIL.

Melania abjecta, ... Haldeman.
" abrupta, ... Lea.
" acicula, (Eulima,) . . Philippi.
" aculeus, ... Lea.
" acuminata, . . . Dunker.
" acuto-carinata, . . . Lea.
" acuta, ... Lea.
" adspersa, ... Torschel.
" Ægyptiaca, . . . Benson.
" æqualis, ... Hald.
" Æthiops, ... Beck.
" afra, ... Zeigler.
" agnata, ... Pfeiffer.
" Alexandrensis, . . . Lea.
" altilis, ... Lea.
" alveare, ... Conrad.
" amarula, ... Lamarck.
" angulosa, ... Menke.
" annulifera, . . . Conrad.
Melania annulata, ... Ferussac.
" anthracina, . . . Von Den Busch.
" approxima, . . . Haldeman.
" arata, ... Lea.
" aretata, ... Lea.
" arcuata, ... Zool. Soc., 1843.
" armigera, ... Say.
" asperata, ... Lamarck.
" aspirans, ... Hinds.
" attenuata, ... Woodward. *f.*
" ater, ... Rich.
" auricularis, . . . Ferussac.
" auriculæformis, . . . Lea.
" auricula, ... Grateloup. *f.*
" aurita, (Pirena, Lam.,) . Rang.
" auriscalpium, . . . Menke.
" Babylonica, ... Lea.
" basalis, ... Lea.
" Batana, ... Gould.

27	M	*solida*	35	M	*Haliaena*	43	M	*pallescens*	[illegible]
28		*Pretius*	36		*pumila*	44		*Buddii*	52
29		*lugubris*	37		*Alexandrinus*	45		*harpa*	53
30		*torta*	38		*ovoidea*	46		*arctata*	54
31		*spurca*	39		*auriculiformis*	47		*crebri striata*	55
32		*abrupta*	40		*carina costata*	48		*nobilis*	56
33		*basalis*	41		*filum*	49		*periodosa*	57
34		*modesta*	42		*spinulis*	50	A	*squalida*	58

Melania bella-crenata, . . . Haldeman.
" bella, ... Conrad.
" bellicosa, ... Hinds.
" bicarinata, . . . Grateloup.
" bilineata, ... Gold, Pfeif. *f.*
" bilineata, ... Pfeif. *f.*
" bitæniata, ... Conrad.
" blanda, ... Lea.
" Boscii, (Eulima,) . . Phil.
" Boykiniana, . . . Lea.
" breviformis, . . . Parreyss.
" brevis, ... Lea.
" Brocchii, ... Brown.
" buccinalis, . . . Deshayes.
" Buddii, ... Lea.
" Byronensis, . . . ?
" caliginosa, . . . Lea.
" Cambessedesii, { Eulima elegantissima, Pay. / Turbo politus, Lam. } Pay.
" campanella, . . . Philippi.
" canaliculata, . . . Say.
" cancellata, . . . Say.
" cancellata, . . . (?)
" canicularis, . . . Lamarck.
" carinifera, . . . Lamarck.
" carino-costata, . . . Lea.
" carinata, ... Ravenel.
" Carolinæ, ... Gray.
" castanea, ... Lea.
" catenarea, ... Say.
" catenoides, . . . Lea.
" Celebensis, . . . Quoy, Desh.
" Cincinnatiensis, . . Lea.
" circincta, ... Lea.
" clathrata, ... Grat. *f.*
" clava, ... Lamarck. *f.*
" clavæformis, . . . Lea.
" clavula, ... Deshayes. *f.*
" coarctata, ... Lamarck.
" cochlearella, (Rissoa,) . Lamarck. *f.*
" coffea, ... Philippi.
" columella, ... Lea.
" comma, ... Conrad.
" concinna, ... Lea.
" congesta, ... Say.
" conica, ... Say.
" conica, ... Gray.
" constricta, . . . Lamarck. *f.*
" cornea, ... Kruster.
" coronata, ... Von Den Busch.
" coronata, . . . Kruster.
" corrugata, . . . Lamarck.

Melania costata, ... Quoy, Desh.
" costata, ... Ravenel.
" costata, ... Sowerby. *f.*
" costata, ... Quoy, Desh.
" costellata, ... Lamarck. *f.*
" costifera, ... Haldeman.
" costulata, ... Lea.
" costulata, ... Mühlfeld.
" crassa, ... Von Den Busch.
" crassa, ... Parreyss.
" crebri-costata, . . . Lea.
" crebri-striata, . . . Lea.
" crenulata, ... Deshayes.
" cruentata, ... Menke.
" Curreyana, . . . Lea.
" curta, ... Haldeman.
" curta, ... Menke.
" curvata, ... Lea.
" curvicosta, . . . Deshayes. *f.*
" Cuvieri, ... Deshayes. *f.*
" cylindracea, . . . Conrad.
" decora, ... Lea.
" decollata, ... Lamarck.
" decussata, . . . Deshayes. *f.*
" Dembea, ... Ruppell.
" depygis, ... Say.
" Deshaysiana, . . . Lea.
" dilatata, ... Con.
" distorta, (Eulima,) . . Defrance. *f.*
" dubia, ... Lamarck.
" dubiosa, ... Lea.
" Duisabonis, . . . Grateloup.
" Duttoniana, . . . Lea.
" ebenum, ... Lea.
" eburnea, ... Mühlfeld. (?)
" Edgariana, . . . Lea.
" elegans, ... Schmidt.
" elevata, ... Say.
" elongata, ... Lea.
" erodes, ... Zeigler.
" erosa, ... Lesson.
" erythrostoma, . . . Quoy, Desh.
" exarata, ... Menke.
" exarata, ... Lea.
" excisa, ... Lea.
" excurata, ... Con.
" exilis, ... Haldeman.
" expansa, ... Lea.
" fasciata, ... Sowerby. *f.*
" fasciata, ... Von Den Busch.
" fasciata, ... Menke.
" fasciolata, ... Lamarck.

Melania figurata, ... Hinds.
" filum, ... Lea.
" flamigera, . . . Dunker.
" flammulata, . . . Von Den Busch.
" flavida, ... Dunker.
" florata, ... Hinds.
" Florentiana, . . . Lea.
" fluminalis, . . . Mühlfeld.
" Foremani, . . . Lea.
" formosa, ... Conrad.
" fragilis, ... Lamarck.
" Frethii, ... Gray.
" fulgurans, ... Hinds.
" fuliginosa, . . . Lea.
" fumosa, ... Hinds.
" funiculus, ... Quoy., Desh.
" fusca, ... Rang.
" fusca, ... Philippi.
" fuscata, ... Deshayes.
" fusiformis, . . . Lea.
" gaudiosa, ... Hinds.
" glabra, ... Lea.
" glabrata, ... Mühlfeld.
" glans, ... Von Den Busch.
" globula, ... Lea.
" globulosa, . . . Grey.
" gracilis, ... Lea.
" gracilis, ... Anthony, Hald.
" grana, ... Von Den Busch.
" granifera, ... Lamarck.
" Haleiana, ... Lea.
" harpa, ... Lea.
" harpæformis, . . . Hock, Desh. *f.*
" harpula, ... Dunker.
" Haysiana, . . . Lea.
" Heddingtonensis, . . Sowerby. *f.*
" Helvetica, . . . Michelin.
" Henriettæ, . . . Gray.
" Hildrethiana, . . . Lea.
" Hollandri, . . . Ferussac.
" Holstonia, . . . Lea.
" hordacea, ... Lamarck. *f.*
" Hugelii, (Melanopsis?) . Philippi.
" Hydei, ... Con.
" impressa, ... Lea.
" inæquata, ... Fischer de Valdh.
" incerta, ... Grat. *f.*
" inermis, ... Gray.
" inflata, ... Lea.
" inflata, ... Haldeman.
" inflexa, ... Phillips. *f.*
" inquinata, ... Defrance. *f.*

Melania integra, ... Say.
" intermedia, . . . Von Den Busch.
" interrupta, . . . Haldeman.
" intersita, ... Haldeman.
" isogona, ... Say.
" Jayana, ... Lea.
" Kirtlandiana, . . . Lea.
" lactea, ... Lamarck. *f.*
" læta, ... Jay.
" lævigata, ... Deshayes. *f.*
" lævis, ... Lea.
" lævissima, . . . Sowerby.
" laqueata, ... Say.
" Largillierti, . . . Philippi.
" latebrosa, ... Hinds.
" Leeontiana, . . . Lea.
" ligata, ... Menke.
" lima, ... Conrad.
" lineata, ... Sowerby. *f.*
" lineata, ... Troschel.
" lineolata, ... Gray.
" livescens, ... Menke.
" lirata, ... Menke.
" luctuosa, ... Hinds.
" lugubris, ... Lea.
" macilenta, . . . Menke.
" maculata, ... Parreyss.
" Madagascariensis, . . Grateloup.
" magnifica, . . . Conrad.
" marginata, . . . Lamarck. *f.*
" Matoni, ... Gray.
" melanoides, . . . Conrad.
" minima, ... Sowerby. *f.*
" mitra, ... Dunker.
" mitra, ... Desh., Lam.
" modesta, ... Lea.
" mœsta, ... Hinds.
" Molluccensis, . . . Quoy, Desh.
" monozonalis, . . . Lea.
" multilata, ... Say.
" multilineata, . . . Say.
" mutans, ... Gould.
" nassula, ... Conrad.
" Niagarensis, . . . Lea.
" Nickliniana, . . . Lea.
" nitens, ... Lea.
" nitida, ... Lamarck.
" nobilis, ... Lea.
" nodulosa, ... Lea.
" nupera, ... Say.
" obovata, ... Say.
" obtusa, ... Lea.

Melania occata, ... Hinds.
" occidentalis, . . . Lea.
" Ocoeensis, . . . Lea.
" oliva, ... Lea.
" olivata, ... Conrad.
" olivula, ... Conrad.
" Ordiana, ... Lea.
" ornata, ... Von Den Busch.
" ornata, ... Grat. *f.*
" ovalis, ... Lea.
" ovoidea, ... Lea.
" ovularis, ... Menke.
" Owenii, ... Gray.
" pallescens, . . . Lea.
" pallida, (Chemnitzia,) . Philippi.
" Papuensis, . . . Quoy, Desh.
" perfusca, ... Lea.
" pernodosa, . . . Lea.
" perpinguis, . . . Hinds.
" picta, ... Lea.
" picta, ... Hinds.
" pilula, ... Lea.
" plicata, ... Menke.
" plicata, ... Lea.
" plicatula, ... Desh.
" plicifera, ... Lea.
" pluristriata, . . . Say.
" Plutonis, ... Hinds.
" polita, ... Desh. *f.*
" portalis, ... Rossmaessler.
" Potosiensis, . . . Lea.
" prærosa, (Anculosa,) . . Say.
" prasinata, . . . Con.
" producta, ... Lea.
" Proteus, ... Lea.
" proxima, ... Say.
" pugilis, ... Hinds.
" pulchella, ... Anthony.
" pumila, ... Lea.
" punctata, ... Lamarck.
" pygmæa, ... Hoch., Desh.
" pyramis, ... Benson.
" pyramidata, . . . Sowerby. *f.*
" pyramidata, . . . Hinds.
" pyrenella, . . . Conrad.
" quadriseriata, . . . Gray.
" Rangii, ... Deshayes.
" regularis, ... Lea.
" Reirvardii, . . . Van Haan.
" retusa, ... Gray.
" Riqueti, ... Grateloup.
" robusta, ... Lea.

Melania Rogersii, ... Conrad.
" rufa, ... Philippi.
" rufescens, . . . Lea.
" rufula, ... Haldeman.
" rugosa, ... Lea.
" salebrosa, ... Conrad.
" Sayii, ... Ward.
" scabra, ... Fer., Desh.
" scalaria, ... Philippi.
" scalarina, ... Pfeiffer.
" scalaris, ... Spix & Wagner.
" Scheideana, . . . Philippi.
" scolopaceus, . . . Lamarck.
" semicarinata, . . . Say.
" semicancellata, . . . Von Den Busch.
" semicostata, . . . Conrad.
" semidecussata, . . . Lamarck. *f.*
" semigranosa, . . . Von Den Busch.
" semiplicata, . . . Lamarck. *f.*
" semistriata, . . . Lamarck. *f.*
" setosa, ... Swainson, Desh.
" siccata, ... Von Den Busch.
" simplex, ... Say.
" solida, ... Lea.
" soluta, ... Philippi.
" sordida, ... Lea.
" spina, ... Grat. *f.*
" spinalis, ... Lea.
" spinifera, ... Adams.
" spinulosa, . . . Lamarck, Phil.
" Spixiana, ... Lea.
" spurca, ... Lea.
" striata, ... Sowerby. *f.*
" striatula, ... Lea.
" strigilata, ... Dunker.
" strigosa, ... Lea.
" stygia, ... Say.
" subcarinata, . . . Gray.
" subcylindracea, . . . Lea.
" subglobosa, . . . Say.
" subsolida, ... Lea.
" substricta, . . . Haldeman.
" subulata, ... Lamarck.
" subularis, ... Lea.
" sulcata, ... Sowerby. *f.*
" sulcosa, ... Lea.
" sulcosa, ... Menke.
" suturalis, ... Haldeman.
" symmetrica, . . . Haldeman.
" Taitiana, ... Lea.
" Tarbelliana, . . . Grateloup. *f.*
" tenebrosa, . . . Lea.

Melania terebella, ... Mühlfeld.
" terebra, ... Von Den Busch.
" terebralis, ... Lea.
" teres, ... Lea.
" testudinaria, . . . Von Den Busch.
" thiarella, ... Lamarck.
" Tirouri, ... Ferussac.
" torquata, ... Lea.
" torquata, ... Von Den Busch.
" torta, ... Lea.
" tricarinata, . . . Woodward. *f.*
" trilineata, ... Say.
" triticea, ... Ferussac. *f.*
" trochiformis, . . . Conrad.
" Troostiana, . . . Lea.
" truncata, ... Lamarck.
" truncatula, . . . Lamarck.
" tuberculata, . . . Muller. (?)
" tuberculata, . . . Von Den Busch.
" tuberculata, . . . Lea.
" tuberculata, . . . Spix & Wagner.
" tuberculosa, . . . Rang.
" turgida, ... Lea.
" turritella, ... Dunker.

Melania tympanorum, (Pirena aurita, Lam.,) Deshayes.
" tympanotonus, . . . Deshayes.
" uncialis, ... Haldeman.
" undulata, ... Say.
" uniformis, . . . Quoy, Desh.
" Vanuxemiana, . . . Lea.
" variabilis, ... Defrance. *f.*
" varicosa, ... Ward.
" varicosa, ... Troschell.
" variegata, ... Menke.
" ventricosa, . . . Rang.
" venusta, ... Lea.
" verrucosa, . . . Hinds.
" vestita, ... Conrad.
" vibex, ... Mühlfeld.
" virgata, ... Lea.
" Virginica, ... Say.
" virgulata, ... Fer., Desh.
" viridis, ... Lea.
" vittata, ... Philippi. *f.*
" Warderiana, . . . Lea.
" Winteri, ... Von Den Busch.
" zonata, ... Von Den Busch.
" Zinkeni, ... Dunker.

Since the preceding sheet was put to press, I have received from Dr. Philippi some numbers of his "Abbildungen und Beschreibungen neuer oder wenig gekannter Conchylien," in which I find the following *Melaniæ* not in the above catalogue. They increase the list of species to four hundred and seventeen.

Melania (Melanopsis,) Braziliensis, . Moricand.
" cingulata, ... Jonas.
" costata, ... Olivier.
" (Melanopsis,) crenocarina, . Moricand.
" Gruneri, ... Jonas.
" (Melanopsis,) Helena, . Meder.
" inhonesta, ... Von Den Busch.
" Javanica, ... Von Den Busch.
" (Melanopsis,) Kotchyi. . Von Den Busch.
" (?) obesa, ... Philippi.

Melania (Melanopsis,) Parreyssii, . Von Mühlfeld.
" porcata, ... Jonas.
" pyramis, ... Von Den Busch.
" rivularis, ... Philippi.
" scabrella, ... Philippi.
" semicostata, . . . Philippi.
" subnodosa, . . . Philippi.
" suturalis, ... Philippi.
" turgidula, ... Philippi.
" (Melanopsis,) variabilis, . Von Den Busch.

SYSTEMATIC INDEX.

	Page
Unio approximus,	74
" atro-costatus,	70
" Binneyi,	77
" caperatus,	75
" caliginosus,	79
" compressissimus,	81
" Estabrookianus,	77
" flavescens,	72
" fuliginosus,	78
" fulgidus,	73
" Gouldii,	76
" hippopœus,	67
" hyalinus,	69
" latecostatus,	68
" pallescens,	79
" pellucidus,	70
" pernodosus,	71
" pulvinulus,	81
" simplex,	76
" symmetricus,	73
Unio spatulatus,	80
" tumescens,	71
" unicolor,	74
" utriculus,	69
Margaritana minor,	82
Anodonta tetragona,	82
Melania abrupta,	85
" arctata,	90
" Alexandrensis,	87
" auriculæformis,	88
" basalis,	85
" Buddii,	90
" carino-costata,	88
" crebre-striata,	91
" filum,	88
" Haleiana,	86
" harpa,	90
" lugubris,	84
" modesta,	86
Melania nobilis,	91
" ovoidea,	87
" pallescens,	89
" pernodosa,	92
" Proteus,	83
" pumila,	86
" solida,	83
" spinalis,	89
" spurca	85
" torta,	84
Aneulosa squalida,	92
" tintinnabulum,	93
Schizostoma Babylonicum,	94
" Buddii,	94
" constrictum,	94
" funiculatum,	95
" laciniatum,	95
" pagoda,	93
Paludina Haleiana,	96

ARTICLE V.

Memoir explanatory of a New Perpetual Calendar, Civil and Ecclesiastical, Julian and Gregorian. By William McIlvaine. Read August 15, 1845.

When my attention at school was first turned to the solution of chronological problems, I received a strong impression that the Dominical Letters formed too complex and cumbrous an appendage of the calendar. According to the directions given in Pike's Arithmetic, at that time a standard elementary work, one of the first seven letters of the alphabet, in regular order, A always standing at the first day of January, must be prefixed to every day in the common year of 365 days. The letter which in this series happened to be affixed to the first Sunday in January was called the Dominical Letter of that year, as marking all its Sundays, but in leap years the next following letter was to serve as the Dominical Letter for the first two months of the year. A, B, C, D, E, F, G, with 1, 2, 3, 4, 5, 6, 7, subjoined, constituted a table, the numbers being an index to the letters. By a rule, whose principle was left unexplained, the sum of the Julian year, its fourth part *and four* was to be divided by *seven*. If no remainder occurred, G was the Dominical Letter, but if any number remained *that* number of letters, beginning the reckoning with F, was to be counted in a retrograde order from G, to reach the Dominical Letter; or on deducting the remainder from *seven* you might obtain the index of the Dominical Letter, counting forwards from A. The rule was shorter for Gregorian years, but in both styles the Sunday letter was double in every leap year, and after the proper letter had been found it was required to count backwards again in order to know on what day of the week the first of January happened. Finally, if the day of the week corresponding with a given day of any other month was wanted, the tedious process of adding the day of the month to the number of days in all the preceding months, and dividing the sum by *seven*, must be gone through, and the answer deduced from another remainder.

The whole system seemed to me "cycle and epicycle, orb in orb," the week appearing to revolve about the letter A, and the year around the week. I had imagined the structure of the Julian year, when once divested of the absurdity of calends, nones, and ides, (all counted backwards,) and after having the week introduced, to be essentially simple; and although the Dominical Letters, for ages consecrated to clerical use, had, I knew, been adopted by the ablest astronomers and chronologists of modern times, and were still employed conjointly with the golden number, by learned judges of the King's Bench, in England, for ascertaining the legal periods of the four terms of court, yet I could not help believing that some less circuitous method would sooner or later supersede an apparatus which, however true in its results, and however lucid in comparison with some other parts of the machinery, causes most persons, from its complexity alone, to consider even the *civil calendar* a subject of much difficulty, and *that of the Church* as an impenetrable mystery. I have, accordingly, always looked with particular interest at the *Perpetual* Almanacs, so called, (but serving only for a single century,) which have since fallen in my way, with a vague hope of being able to discover in them the germ of some simpler mode of computation.

On consulting, about two years ago, the *seventh* edition of the Encyclopedia Britannica, I met accidentally with a new, well-digested, and perspicuous article on the "Calendar," from the pen of Thomas Galloway, Esq., F. R. S., one of the Vice-presidents of the Royal Astronomical Society, and was gratified at learning from it how much had been done within the present half-century, by the analytical skill of Gauss and Delambre, towards disencumbering the calendar of numerous tables, and substituting for them plainer formulæ. I perceived, however, and not without disappointment, that the Dominical Letters were still retained among the elements of the algebraical equations, and on applying them arithmetically I found my computation embarrassed at the outset by the quantity $7m$ joined with many quantities differing in sign, contained in the first equation, and at the close, by another inconvenient equation, $p = P + (L - l,)$ involving the value not only of the Sunday letter, but of a letter belonging to the fifteenth day of the calendar moon.

After a careful reperusal of Mr. Galloway's essay, I was struck with the fact to which I had never before adverted, that the first year of the Christian era began with Saturday, which, being the seventh day of the week, and corresponding with *seven*, the number of the hebdomadal cycle, suggested to me the possibility of making that number a convenient starting-point of an indefinitely prolonged succession of ages or chronological periods, in which the ordinal numbers appropriate to the other six days of the week, might perform in a direct and more natural and intelligible manner, the same function that the Dominical Letters, in a reversed order and in connexion with the Solar Cycle, had heretofore done. Pursuing, as the amusement of many leisure hours, this casual thought, I have succeeded in constructing what I believe to be a *new instrument*, of plain materials, but rather better adapted than the old, for ordinary, popular use, and perhaps of a labour-saving character, even in the hands of the learned; although to this last consideration I wish to be understood as not attaching much importance, but merely as asking the opinion of mathematicians in regard to the plan, if, at first blush, they should deem it at all worthy of

their scrutiny. To them a difference of "methods," technically so called, being, for the most part, of little consequence, my proposal to "*free* the civil calendar from algebraic formulæ," (which are apt to convey, to their minds, the best evidence and guidance.) may at first sound strangely; but the attempt will possibly appear to them, upon reflection, quite consonant with the improved spirit of the present age, which brings, whenever practicable, things of common concern and use to common comprehension. In regard to the Church calendar, indeed, which Delambre declares to be "excessivement compliqué et qui. pour être bien compris, exige l'attention la plus soutenue," I must admit it to be doubtful whether in any shape yet assumed, it is likely to become an inviting or fruitful object of inquiry to the generality of persons.

The next page exhibits, and the succeeding one exemplifies my plan, the constituent parts of which are embodied in a single Tablet or Perpetual Calendar, having its peculiarities specified in the title. In addition to the two general *Rules*, it will be seen to consist, principally, of a central column, headed "Eras," which serves as an index to two series of corrections, called (in compliance with customary fictions and nomenclature,) the Solar and Lunisolar Equations. These are comprised in two side columns of equal length with the central one, and accompanying it; column A being appropriated to civil, and column C to ecclesiastical purposes.

The Julian Era, though employed by astronomers as a convenient universal measure of time, is here limited to years *after* Christ, but embraces, of course, all those years which *precede* the adoption of the reformed calendar, at various epochs, by the several nations of Christendom. That is to say, the equations 5 and 0 respectively, standing at the head of the side columns, and "beside" the Era denominated "Julian after Christ," are intended to be used *constantly* until such a reformation has actually taken place. The Era denominated "Gregorian from 1582," is divided into centurial figures, but the equations standing beside these subdivisions are not meant to be applied to the interval, for example, of nearly 170 years which occurred between the adoption of the New Style at Rome, and in Great Britain. Without this preliminary caution, the word "Eras," as employed in the tablet, might possibly mislead some readers.

The asterisks annexed to the centurial figures are not essential to the use of the Tablet, but are retained for the purpose of better elucidating its structure. The intervals between them on the *civil* side, make known, however, at once, through the eye, those *centesimal* years which, in New Style, are not bissextile; and they furnish also a ready means of ascertaining the whole number of days, by which, at any period after 1600, the two styles differ from each other. For instance, in years having the centurial figures 26, the difference between Old and New Style amounts to 18 days: for 10 (the number of days originally suppressed,) together with the 8 centurial figures which are destitute of asterisks, (viz., 17, 18, 19, 21, 22, 23, 25 and 26,) make the sum 18: in like manner, the difference, with our present centurial figures is 12 days: for 10 + 2 (17 and 18 being unmarked) = 12.

The two auxiliary tables B and D demand no attention until some progress shall have been made in the explanations of the general rules, upon which I am now to enter.

PERPETUAL CALENDAR,

CIVIL AND ECCLESIASTICAL,

Freed from Dominical Letters, Solar Cycle, Golden Numbers, Extended Tables of Epacts and Algebraic Formulæ. By Wm. McIlvaine. 1844.

RULE.

To find on what day of the week a given day of the month falls in any year after CHRIST, to the end of Time.

Add to the Year,
its **4**th part, (omitting fractions,)
the Eq. in column **A**. beside the Era,
the *number for the month* in Table **B**,
and the Day of the Month.

(or the excess over 7s in the Day of the Month.)

Divide the sum by 7,

The excess over **7**s, calling **0** always **7**, will be the day sought, viz.:

The **1**st, **2**d, **3**d, **4**th, **5**th, **6**th, **7**th,
Being **Su. M. Tu. W. Th. F. Sa.**

Except in Jan. and Feb. of Leap years, when the *preceding* will be the true day.

All JULIAN Years, when multiples of **4**, are Leap Years. GREGORIAN years, when multiples of **4**, are also Leap Years, *Unless* their two right hand figures be **00**, joined with left hand or centurial figures which are *not* multiples of **4**.

Table B.

Numbers for the Months.

		Feb.		
Ist Quarter. Jan.	**0**	**3**	**3**	Mar.
IId. " April	**6**	May. **1**	**4**	June
IIId. " July	**6**	Aug. **2**	**5**	Sept.
IVth. " Oct.	**0**	**3**	**5**	Dec.
		Nov.		

The No. for *each* Month in Table **B**. is the number of days beyond full weeks, in *all* the Months which precede it from the beginning of a Common Year.

The order and position of the figures **3, 6, 5**, (the number of days in a common Year,) and of **1, 2, 3, 4, 5**, in the space between them, may recall to memory the whole Table.

Solar Equation.	ERAS.	Luni-solar Equation.
A	**Julian,** After Christ, UNVARIED.	**C**
5		0
	Gregorian, From 1582, VARIED BY Centurial figs.	
2	**15**	1
2	* **16**	1
1	**17**	0
0	**18** *	0
6	**19**	29
6	* **20**	29
5	**21** *	29
4	**22**	28
3	**23**	27
3	* **24** *	28
2	**25**	27
1	**26**	26
0	**27** *	26
0	* **28**	26
6	**29**	25
5	**30** *	25
4	**31**	24
4	* **32**	24
3	**33** *	24
2	**34**	23
1	**35**	22
1	* **36** *	23
0	**37**	22
6	**38**	21
5	**39** *	21
5	* **40**	21
4	**41**	20
3	**42**	19
2	**43** *	19
2	* **44**	19
1	**45**	18
0	**46** *	18
6	**47**	17
6	* **48**	17
5	**49** *	17
4	**50**	16
3	**51**	15
3	* **52** *	16
2	**53**	15
1	**54**	14
0	**55** *	14
0	* **56**	14
6	**57**	13
5	**58** *	13
4	**59**	12
4	* **60**	12
3	**61** *	12
2	**62**	11
1	**63**	10
1	* **64** *	11
0	**65**	10
6	**66**	9
5	**67**	8
5	* **68** *	9
4	**69**	8
3	**70**	7
2	**71** *	7
2	* **72**	7

RULE.

To find the Calendar-Moon's age on the 1st day of January in any Year, from the beginning of the CHRISTIAN ERA.

Add to ten times the Year,
the Year,
† its **19**th part, (omitting fractions,)
and the Eq. in col. **C**, beside the Era.

† (But if no fraction, add 1 less than the 19th part *in Julian Years.*)

Divide the sum by 30,

The Excess over **30**s. calling **0 = 30**, will be the Age sought, or *Annual Epact.*

Table D.

TO FIND EASTER SUBTRACT ANY EPACT — GREGORIAN. Between	GREGORIAN. From	JULIAN. Between	JULIAN. From	The Diff. will be the DAY of the MONTH on which occurs the Paschal Term.
1 & 12	**13**	1 & 4	**5**	in April.
13 & 23	**44**	5 & 15	**36**	in March.
‡25 & 30	**43**	17 & 28	**35**	in April.
Subtract **24**	From **42**	Subtract **29**	From **34**	

‡ 25 also from 42, if in getting a 19th of the year the Remainder exceed 10.

— This is the Epact 25′ of the Tables in the Article "Calendar," Encyclopedia Britannica, 7th Edition.

Then find by the CIVIL CALENDAR the Day of the Week on which *that* Day of the Month falls, and the following Sunday will be EASTER SUNDAY.

The number of days to be counted forwards will be shown by subtracting *the Day of the Week* thus found, from 8.

EXAMPLES.

OLD STYLE.

What Day of the Week was April 2d, A. D. 326?

4)	326
	81
A	5
Mo.	6
Day	2
7)	420
	60
Remainder	0
or	7
Answer Saturday, Thence	

Required Easter, A. D. 326.

	3260
19)	326
	17
C	0
30)	3603
	120
Rem. or Epact	3
Taken from	5
Term *April,*	2
. . . *to Sunday*	1
Answer April	3

NEW STYLE.

What Day of the Week will be March 22d, A.D. 1845?

4)	1845
	461
A	0
Mo.	3
Day	22
7)	2331
	333
Remainder	0
or	7
Answer Saturday, Thence	

Required Easter, A.D. 1845.

	18450
19)	1845
	97
C	0
30)	20392
	679
Epact	22
From	44
Term *March*	22
. . . *to Sunday*	1
Answer March	23

Rule proved by examples from De Morgan. See British Almanac and Companion, for 1845.

Julian Year.

4)	1639
	409
A	5
Mo.	6
Day	10
7)	2069 Rem.
Wednesday,	4
From	8
	4 . . . . . to Sunday 4

Easter.

	16390
19)	1639
	86
C	0
30)	18115
Epact	25
From	35
Term April	10
Same Answer, April	14

Gregorian Year.

4)	4610
	1152
A	0
Mo.	6
Day	13
7)	5781 Rem.
Friday	6
From	8
	2 . . . . . to Sunday 2

Easter.

	46100
19)	4610
	242
C	18
30)	50970
Epact	30
From	43
Term April	13
Same Answer, April	15

Rule proved by examples from Delambre. See Conn. des Tems for 1817, and Hist. de l'Astron. Mod.

Julian Year.

4)	4763
	1190
A	5
Mo.	6
Day	12
7)	5976 Rem.
Thursday	5
From	8
	3 . . . . . to Sunday, 3

Easter.

	47630
19)	4763
	250
C	0
30)	52613
Epact	23
From	35
Term April	12
Same Answer, April	15

Gregorian Year.

4)	3909
	977
A	5
Mo.	6
Day	17
7)	4914 Rem.
Saturday	0 = 7
From	8
	1 . . . . . to Sunday 1

Easter.

	39090
19)	3909
	205
C	21
30)	43225
Epact	25
From	42
Term April	17
Same Answer, April	18

The point of view in which the subject presented itself will probably be best understood by expanding my original course of reasoning into figures in the following way:

The 1st day of year 1 of Christ, having the Sunday letter B, was SATURDAY, or the 7th day of the week; which number 7 agreeing with that of the weekly cycle, (never to be interrupted,) suggests this plan of freeing the calendar from Dominical Letters.

If (referring to the following Table, SERIES I.,) to the 1st day of the year 1 we add 5, in order to reach and include the 7th or last day of that cycle, the sum 7 divided by 7, gives us the remainder 0; which remainder being always taken as the equivalent of 7, the divisor (conformably to arithmetical usage in the case of all other cycles,) becomes a fit expression for SATURDAY: and 0, or a week completed, will thus represent perpetually that day of the week in the scale of time.

The same process with the succeeding ordinal days of the year, exhibits a perfectly correct expression for the other six intermediate days of the week, as in

SERIES I.—*Days of the Common Year.*

To day the . .	1st	2d	3d	4th	5th	6th	7th	8th	15th	22d	29th	365th
Of year . . .	1	1	1	1	1	1	1	1	1	1	1	1
Add constantly. .	5	5	5	5	5	5	5	5	5	5	5	5
Divide by 7 the sum	7	8	9	10	11	12	13	14	21	28	35	371
There remains .	0	1	2	3	4	5	6	0	0	0	0	0
Or	SAT.	SU.	M.	T.	W.	TH.	F.	SAT.	SAT.	SAT.	SAT.	SAT.

NOTE.	
Rejecting 7s from 365 leaves	1
Then adding year	1
And Constant	5
We get the sum	7
And same Rem'r	0
or SAT.	

Showing that

Year 1 *begins* and *ends* (52 entire weeks, or 364 days intervening) on 0 or SATURDAY.

A like Table for succeeding years would show

in year 2, its *first* and *last* day, . . . by the Remainder 1 to be SUNDAY,

in year 3, its *first* and *last* day, . . . by the Remainder 2 to be MONDAY.

Year 4 is a leap year, but not until the 29th of February;

its *first* day, therefore, would be shown . . by the Remainder 3 to be TUESDAY,

and its *last*, or 365th day, ... by the Remainder 4 to be WEDNESDAY.

This result for the end of the year 4 would be the same if, instead of calling its last the 366th day, . . we add to the 365th day of a common year,

the year	4
then, by the general rule, its fourth part	1 for the first Leap Year of the Era,
and constant	5
The sum	375 divided by 7, gives Remainder 4 or WEDNESDAY for the 31st of December.

But this rule, as applied to the beginning or 1st day of January of the year 4, would make it also to be Wednesday, which is not the true day, but *Tuesday is*, as we have seen above. Hence the exception stated in regard to the months of January and February in leap years, viz., to take the *preceding* as the true day, since no intercalation occurs until the 29th of February. I proceed to show the effect of *seven* such *quadrennial* intercalations to advance by exactly a week, the day of the week, after going through the first complete cycle of the Julian Era.

Accordingly, using as before the day of the year and the constant, which for our present purpose (see NOTE to *day* 365th,) are together, always 6, or (1 + 5) the

Year 5, with its $\frac{1}{4}$ part, (a whole No.)	or 1,	added to	6,	make the sum	12	and Rem.	5.	It begins and ends on		Th.
6	"	"	or 1,	"	6	"	13	"	6	"	F.
7	"	"	or 1,	"	6	"	14	"	0	"	Sat.
8	"	2, less 1 till Mar.	or 1,	"	6	"	15	"	1	It begins	Su.
9	"	2, less 0 after Feb.	or 2,	"	6	"	16	"	2	It ends	M.
"	"		or 2,	"	6	"	17	"	3	It begins and ends on	Tu.
10	"		or 2,	"	6	"	18	"	4	"	W.
11	"		or 2,	"	6	"	19	"	5	"	Th.
12	"	3, less 1 till Mar.	or 2,	"	6	"	20	"	6	It begins	F.
"	"	3, less 0 after Feb.	or 3,	"	6	"	21	"	0	It ends	Sat.
13	"		or 3	"	6	"	22	"	1	It begins and ends on	Su.
14	"		or 3	"	6	"	23	"	2	"	M.
15	"		or 3	"	6	"	24	"	3	"	T.
16	"	4, less 1 till Mar.	or 3	"	6	"	25	"	4	It begins	W.
"	"	4, less 0 after Feb.	or 4	"	6	"	26	"	5	It ends	Th.
17	"		or 4	"	6	"	27	"	6	It begins and ends on	F.
18	"		or 4	"	6	"	28	"	0	"	Sat.
19	"		or 4	"	6	"	29	"	1	"	Su.
20	"	5, less 1 till Mar.	or 4	"	6	"	30	"	2	It begins, ...	M.
"	"	5, less 0 after Feb.	or 5	"	6	"	31	"	3	It ends	T.
21	"		or 5	"	6	"	32	"	4	It begins and ends on	W.
22	"		or 5	"	6	"	33	"	5	"	Th.
23	"		or 5	"	6	"	34	"	6	"	F.
24	"	6, less 1 till Mar.	or 5	"	6	"	35	"	0	It begins	Sat.
"	"	6, less 0 after Feb.	or 6	"	6	"	36	"	1	It ends	Su.
25	"		or 6	"	6	"	37	"	2	It begins and ends on	M.
26	"		or 6	"	6	"	38	"	3	"	T.
27	"		or 6	"	6	"	39	"	4	"	W.
28	"	7, less 1 till Mar.	or 6	"	6	"	40	"	5	It begins	Th.
"	"	7, less 0 after Feb.	or 7	"	6	"	41	"	6	It ends	F.
29	"		or 7	"	6	"	42	"	0	It begins and ends on	Sat.

In this list of years, SATURDAY corresponds in one leap year (12,) with the *last* day of the year only; in another leap year (24,) with the *first* day only; and in two common years, (7 and 18,) being the *third* and *second* after leap year, with *both the first and last day:* but it is in years 1 and 29 alone, that all the conditions of the Julian Year become exactly alike.

Thus, after a lapse of 28 entire years,
(of which the . 21 common years contain . 7665 days, or exactly . 1095 weeks,
and the . . . 7 leap years contain . . . 2562 days, or exactly . 366 weeks,
making in all . 28 years, or . . . . . 10227 days, or . . . . 1461 weeks,)
between the first days of January in the years 1 and 29, both of these years being the *first* after bissextile, SATURDAY returns to be the first and also the last day of the year. In the years 30, 31, 32, &c., down to 57, all the days of the week will recur in the same order as in 2, 3, 4, down to 29, at the beginning and end of years having a common relation with leap year, and so on *for ever.*

The rule of the Tablet is therefore perfectly consonant with the well-known law of the Solar Cycle and Dominical Letters in the Julian Calendar, and it is evident to the mere arithmetician, that the part which the Equation 5 plays, in the type or first cycle of that Calendar, just exhibited at large in connexion with the initial and final *day of the year*, would be equally well performed by it, in conjunction with any intermediate ordinal day of those years, or with any other Old Style year, without limitation.

But thus far we have not considered the year as divided into *months and days of the month*, both of which are embraced as elements of computation in our general rule.

On carrying out the plan of the foregoing Table, and introducing every month, it will be seen that the *first* days of each month are equivalent to the following ordinals of the common year, placed in the upper line of

SERIES II.—*First Days of the Months.*

Months . . .	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Day of the Year	1	32	60	91	121	152	182	213	244	274	305	335
Year, ...	1	1	1	1	1	1	1	1	1	1	1	1
Constant . . .	5	5	5	5	5	5	5	5	5	5	5	5
Sum divided by 7	7	38	66	97	127	158	188	210	250	280	311	341
Remainder . .	0	3	3	6	1	4	6	2	5	0	3	5
or Day of the W'k	SAT.	TU.	TU.	FR.	SU.	W.	FR.	M.	TH.	SAT.	TU.	TH.

Now these Twelve Remainders disposed in Quarters of a year, (and in a form and order quite as easily remembered as the usual tabular index to the Dominical Letters,) constitute Table B of the Perpetual Calendar. They are called Nos. for the respective months, and on being substituted for the corresponding ordinals of the year standing in the upper line, will, when the first day of the month comes to be added with them to the year and the constant 5, yield the very same remainders, and so indicate correctly the day of the week on which each month of the first year of the Christian Era begins.

0, the monthly number for January, marks the true zero of the civil year, or the midnight between the old and the new year: and this No. added to the day of the month, equals throughout January the ordinal day of the year. The rest of the monthly Nos. mark the midnights preceding the first day of each subsequent month, expressed in the odd days over full weeks, counted from the same zero-point: and this distance, together with the days of each month in succession, must, of course, equal the other ordinals throughout the year. But since the rejection of entire weeks (or division by 7,) does not affect the day of the week, the sum of the monthly No. and the day of the month, may be substituted uniformly for those ordinals. Thus the 31st of December, whose monthly No. is 5, added to the year 1, its fourth part 0, and the constant 5 = 42, which sum divided by 7 gives us 0, or Saturday, the same result as when calling it the 365th day in SERIES I. Either an additional year, or an additional day of the month, or an additional 29th of February in every fourth year, advances by 1 the day of the week as regularly and permanently, through an infinite succession of weekly cycles, as we have already found them to do, in the computations connected with that series, in which 0, the No. for January, with 1, the day of the month, might have been used as equivalent to 1, the day of the year.

It is demonstrated, therefore, that the use of Dominical Letters, whether single or double, may be entirely dispensed with in the *Julian* Calendar. The Solar Equation or Constant 5, standing at the head of column A, effects for ever, with the aid of Table B, by a process almost purely additive, the same object in a simpler and easier way; and supplies the place, not only of the whole apparatus of *Regulars* and *Concurrents* heretofore combined with the *Solar Cycle*, but also of the memorial lines usually employed for ascertaining the first day of every month, in a manner which was not, however, readily applicable when the year happened to begin on any other day than Sunday. It may not be unworthy of a passing notice that (regarding the solar regulars *one* and *eight* as the same,) each of the twelve monthly numbers of Table B, viz., 0, 3, 3, 6, 1, 4, 6, 2, 5, 0, 3, 5, is less by 2 than each of the ancient Solar Regulars, 2, 5, 5, 1, 3, 6, 1, 4, 7, 2, 5, 7, and is less by 1 than the respective numbers . . . 1, 4, 4, 7, 2, 5, 7, 3, 6, 1, 4, 6, representing the order, in the alphabet, of the initials A, D, D, G, B, E, G, C, F, A, D, F, of the twelve words composing the doggerel rhyme which we have just referred to, namely, "At Dover Dwell, George Brown Esquire; Good Christopher Finch, And David Friar."

From the Constant 5, thus perfectly established as a starting point, is readily deduced the retreating series of small secular equations which follow it in the same column, and these will, in turn, answer equally well for finding the day of the week belonging to any day of any month, in any year throughout the *Gregorian* Era. For the *first* step in the reformation of the Julian Calendar, in 1582, taken for the purpose of restoring the equinoxes to their former place in the year, consisted in the suppression of 10 days in that year by calling the day which was the fifth of October, in the Old Style, the 15th of October in the New. On applying the Rule given in the Tablet, the Julian 5th of October, 1582, will be shown by the Remainder 6, to have been *Friday*, but the Julian 15th of October, being a week and three days farther on, would, by the same rule, be found to happen on *Monday*. Now the series of days of the *week* was not interrupted, nor intended to be, by the reform. The days of the *month only* were to be differently named after 10 of them should be expunged. The epoch, day, or point of time called in the Julian Calendar, the 5th of October, must continue to be Friday in the Gregorian, and be referred to as the 6th day of the week, whatever new denomination it might receive as a day of the month. In order, then, to make the 15th of October in the New Style correspond with Friday, it is obvious that we must go back three days in the calculation, or in other words, that from the Julian Solar (or rather Hebdomadal) Equation of . . . 5
must be deducted, the excess over a full week of the 10 days lost, or 3
and that thenceforward, during a certain period, the Gregorian solar correction or —
equation must be 2
which number stands opposite, in Column A, to the first centurial figures, namely to 15 and 16.

This equation 2 would for ever perform the same office in the Gregorian that 5 had done, and still does, in the Julian Calendar, but for a *second* step taken at the Reformation. With a view to prevent in future that deviation of the nominal civil *Days* from the definite *Seasons* of the year which had arisen from introducing too many leap years, it was then determined that after 1600, which continued bissextile in both Calendars, every suc-

ceeding hundredth year whose centurial figures were not divisible by 4 without a remainder, should cease to be leap years, but that every 400th year whose centurial figures were multiples of 4, should continue to be leap years. These multiples, 16, 20, 24, &c., are, accordingly all marked on the Civil side of the Calendar with asterisks, but the intermediate centurial figures 17, 18, 19, and 21, 22, 23, &c., on the same side, are left unmarked.

Now whenever an asterisk occurs, no change takes place in the solar equation; but at each of the three other centurial figures that equation is diminished by a unit, on account of the one day lost at each successive non-intercalation of the 29th of February. The equation 2 *beside* 15, continues, of course, to be 2 at 16. From 16 downwards, the equations limited by the weekly cycle of 7, (which number is always represented by 0 in column A,) fall into sets of *four* each, in a receding series, each new set of four beginning with the same figure with which the last set ended; and 2 followed by 2 reappears at the centurial figures 43, 44, &c., and at 71, 72, &c., thus returning after *four times seven*, or twenty-eight centuries, to the same figure, or Solar Equation 2, and so on *ad infinitum*.

Column A, consisting of fewer figures (and these symmetrically disposed in a cycle of 7) than have ever been used in constructing any Table of Dominical Letters for *either* style, completes, accordingly, A CIVIL CALENDAR of simple form and unlimited range.

From the terms of the Rule, it is obvious that the Remainder on division by 7 of the first three items, (viz., the given year, its fourth part, and the secular correction in column A,) forms a standing number, which, being once obtained and noted on New Year's day, may serve a convenient purpose throughout that year. This Remainder is universally the complement to 8 of the Dominical number for the year, and might be called the *Yearly Number*.

Then, supposing the Monthly Numbers well fixed in the memory, (a task which the division of Table B into a thick-lined polygon, resembling a carpenter's square, containing twice 3, 6, 0; and a thick-lined square containing a 5, leaving an interval composed of squares less strongly marked, but numbered in regular order, 1, 2, 3, 4, 5, greatly facilitates,) the day of the week will be readily found without resort to an Almanac, by adding together the Yearly No., the Monthly No., and the Day of the Month, and rejecting the sevens from their sum. Since this sum never exceeds 43, the whole process may be *mentally* performed without difficulty, after a little practice. During the present century, whose solar equation is 0, the computation is particularly easy; for instance,

The Remainder or Yearly No. for 1845, to be kept in mind is $\left(\frac{1845 + 461 + 0}{7} = \right) 3$

What day of the week, then, is August the 15th? Add that day of the month, . . 15

And the Monthly Number, 2

The sum is 20

which, divided by 7, (or mentally rejecting the sevens,) leaves the Remainder . . 6

or Friday. In leap years the exceptions respecting January and February must, of course, be attended to. Those exceptions might, instead of referring to the *preceding* day of the week, have been equally well provided for by the following direction, viz., "In January and February of leap Years, use the monthly numbers of July and August, in each case six months distant."

The solar equation belonging to any Gregorian century beyond the limits of the Tablet might be found, by numbering from 0 to 28, the equations in Column A, opposite to the centurial figures lying between 28 and 56. For, since the secular corrections recur in like order, at every succeeding period of four times seven centuries, *that* equation to which the Remainder, on dividing the given centurial figures by 28, stood attached, would be the Equation required, which may likewise be obtained without the use of tables, by a short rule given hereafter, near the close of the memoir.

I proceed to explain, as briefly as possible, the construction of the Ecclesiastical side of the Calendar, and the means I adopted, soon after the civil side had been completed, of connecting them with each other, thus making two of the monthly numbers in Table B, namely 3 and 6, still representing March and April, contribute towards shortening the calculations respecting Easter; and causing also a single additional Column, C, to serve as a convenient substitute for an extended table of thirty lines of Epacts, indexed with as many alphabetical letters, great and small, and consisting of nineteen numbers in each line.

Aided by Mr. Galloway's article, before referred to, and by one of Lord Macclesfield's, published in the Philosophical Transactions of 1750, (No. 494, page 417,) I found the task less difficult than I had anticipated. They describe the ingenious, but involved and intricate mode of expressing, in the Church Calendar, successive differences between Solar and Lunar years, by means of Epacts or Increments. These Epacts are so derived from the Golden Numbers, (that is, from the order in which the years stand in the Metonic cycle of 19 years,) as to indicate the age, at the beginning of each year, of an imaginary moon, whose artificial phases, though approaching, seldom correspond with, but are generally a day or two in advance of, the mean movements of the true moon. They state that, supposing the Epact of the year 1 to be 11, (that is, the difference between the common Solar year of 365 days and the Lunar year of 354 days,) the Epact of each following year of the *first* cycle of 19 is obtained, by adding 11 to that of the former year, and by rejecting 30, as often as the sum exceeds 30; but that at the 20th, 39th, 58th, 77th, &c., years, viz., at the beginnings of each succeeding cycle, 12 is to be added to the epact of the last year of each preceding cycle, and continued augmentations of 11, and rejections of 30, are to take place as before. Hence I inferred that the Golden Numbers, as *Remainders* on division by 19 of the year *plus* 1, might be dispensed with, and their place in computation be conveniently supplied, by adding to 11 times the year, the 19th part of the year, used as a quotient, or *whole Number;* taking care only that, when the Julian year happens to be a multiple of 19, one less than the 19th part shall be added. This easy formula yielded me, without a failure, the constantly recurring 19 Epacts that mark the ancient calendar, beginning with 11 and ending their round with 29; and the General Rule at the head of my Tablet, as there modified, is precisely an equivalent for it, but provides, at the same time, a practical advantage in the arrangement of the figures. The omission of fractions advances by 1, in the order prescribed, each successive set or cycle of Epacts, while the exception stated, guards effectually against the intercalation of 1 taking place at any earlier date than the proper cycle; just as, in the Civil Calendar, 1 less than one-4th part of the year is added in January and February of leap years. The reason

is the same also, for omitting the fractions occurring between multiples of 19, in the Church Calendar, as those occurring between multiples of 4, in the Civil.

With a view to demonstrate, without a large array of figures, the consistency of my Rule with well-established tabular modes of finding the Epact, I refer to the extended Table of Epacts in the Encyclopedia Britannica, (article "Calendar," page 12,) where, in line *c*, beginning with 11, will be found all the Julian Epacts, under a Golden Number, however, always one behind, or one less than, that which was originally assigned to the year. A. D. 1 was, in the old Calendar, always regarded as year 2, of the cycle of 19. This relation between the Golden Numbers and the Epacts was changed at the reformation, when the line D, beginning with 1, was selected for the Gregorian Epacts between the years 1582 and 1699, inclusive, and the . . . . . Epacts 1, 12, 23, 4, &c. were made to correspond with the Golden Numbers . . . . 1, 2, 3, 4, &c.

The Julian Epact for 1582, found by my Rule, and confirmed by the elaborate chronological Table contained in "The Art of Verifying Dates," a work of great learning and acknowledged authority, is 25, the same that is presented in the line *c*, of the extended Table of Epacts, under the Golden Number 5, (that of the Julian year being 6.) Descending *ten places* in that *column*, on account of the ten days suppressed at the reform, or, what comes to the same thing, deducting from the Julian Epact of 25
the number of days suppressed, or 10

we reach, or obtain . 15
But the advance of one Golden Number in the *line* D is equivalent to the addition of 11

and thus causes the Gregorian Epact for 1582 to be 26;
for 1583, to be 7; for 1584 to be 18; and so on; that is to say, makes it always greater by 1 than the Julian, until 1700, unless the years be multiples of 19, in which case the Julian Epact, as the Exception provides, will become always 29, and the Gregorian will be 1. The 15, in the transition from one style to the other, is not an Epact of the year in either, but a connecting link between the two. The Gregorian Epact, at that epoch, is in reality greater by a unit than the Julian; and the Julian Equation, standing at the head of Column C in my Tablet, being 0 *for ever*, the proper starting-point for the Gregorian Equations is 1, which number accordingly stands at the right hand of the centurial figures 15 and 16.

The succeeding Lunisolar equations, 0, 29, 28, &c., were reached in the following manner. Lord Macclesfield's directions for determining "in what years the Epacts should either be extraordinarily augmented or diminished, and the Golden Numbers should either be set backwards or forwards in the Calendar," according to the divisibility of the even hundreds by 3 or by 4, separately, or by both 3 and 4, or by neither, led me to the expedient, similar to the one I had already adopted in regard to the secular equations in the Civil Calendar, of marking with an asterisk, in strict obedience to the Gregorian law, every centurial figure at which, in successive periods of 25 centuries, (beginning at 1800, 4300, 6800, &c.,) the Epact is to be increased by a *unit*. This correction occurs at the end of every 300 years, 7 times in succession, and then *once* at the end of 400 years, making 8 corrections in the course of 2500 years.

The mere relative position of these right-hand asterisks, to those already placed on the left, serves to ascertain without calculation, the coincidence or otherwise, of the prescribed secular adjustments: and to indicate at once, by a process rather more direct and simple than Lord Macclesfield's, the joint effect upon the Calendar Moon's Age, of the *omission*, three times in every 400 years, of a 29th of February, on the one hand; and of the *addition*, eight times in every 2500 years, of an *extra*-Epact, on the other. For it is obvious, with reference to the normal bissextile intercalation of the Julian Calendar, and to its recurring Epacts, which depend upon the Golden Nos., and are, through them connected with the Gregorian Epacts, by a definite law both of analogy and deviation, that on the *left*, an asterisk means *deduct nothing;* a blank means *deduct one day:* and that on the *right*, an asterisk means *add one day;* a blank means *add nothing.*

NOW having at the Cent. Figs. 15 and 16 as a fixed point of departure, the Equation 1†

if	at	17	we deduct	1	and add	0	it falls to	0 or 30
if	at	18	"	1	"	1	it remains	0
if	at	19	"	1	"	0	it falls to	29
if	at	20	"	0	"	0	it remains	29
if	at	21	"	1	"	1	it remains	29
if	at	22	"	1	"	0	it falls to	28
if	at	23	"	1	"	0	it falls to	27
if	at	24	"	0	"	1	it rises to	28
if	at	25	"	1	"	0	falls again to	27
if	at	26	"	1	"	0	it falls to	26, &c.

WHENCE we draw the following *general*, and almost mechanical, *Rule* for obtaining the whole series of Lunisolar Equations in Column C, viz.:

Descending from century to century in the central Column of Gregorian Eras,
Keep the Equation the same as before, when a single * occurs on *either* side;
Diminish the last equation by 1 when the *asterisk* appears on *neither* side;
And *increase* the last equation by 1 when the * * appear on *both* sides;

but limiting, of course, this generally, but not uniformly, receding series by the cycle of 30 or 0. In this manner is readily produced a succession of suitable Epacts, susceptible of indefinite extension, and requiring no supplementary precepts, such as Lord Macclesfield conceived would become necessary after the year 4199.

Before that distant age arrives, the Civil Calendar will doubtless undergo the slight modification generally recommended by modern astronomers, of omitting a single bissextile intercalation at every 1000th year, which would maintain an almost perfect accordance between the seasons and the beginnings of the year, for a thousand centuries to come; and the Ecclesiastical Calendar also will most probably receive, cotemporaneously.

† Although the Equation 1, on the right of the Centurial figures 16, results necessarily from the arbitrary appropriation of the Epact 26, with the Golden Number 6, to the first year of the Reformed Calendar, and does not depend upon, (but is the same with,) the preceding Equation, it nevertheless *happens*, in consequence of no leap year being suppressed until 1700, and of no Epact being added until 1800, to obey the general law of the asterisks, as expressed in the text.

some new adjustment. But, pursuing, without regard to future reforms of either Calendar, the plan I have just described as far as the 87th centurial figures, and comparing, at every step, the *results* derived from my General Rule, when applying the successive equations so obtained, with the *Epacts* set down in the extended Tables, I found them to be in exact correspondence with each other, line by line, and letter by letter, throughout the circuit, from little *a* to capital *P*. In fact, the equations in Column C are identical with the figures, which stand in the first column of Table II. (Encyclop. Brit., Art. "Calendar,") under the Golden Number 1, and immediately by the side of the 30 letters running up the column from D to C. Delambre pronounces the Epact-letters useless; I trust, therefore, that for discarding them, in company with the Dominical, from my Tablet, I shall not incur the reproach of being hostile to *Letters in general.*

The Gregorian Annual Epact being thus accessible, with very little more trouble than the ordinary process of finding the Golden Number, (since three, out of the four lines of figures to be added together, require no computation, but merely to be set down on paper in the order stated,) it remains for me to elucidate my mode of deducing from the Epact the Paschal Term, or the 14th day of the Paschal Moon, (most commonly, but improperly called "The Paschal Full-Moon,") on which Easter Sunday depends.

The Paschal Moon is that whose 14th day, counting the new moon as the *first*, never falls earlier than the 21st of March, nor later than the 18th of April, reckoning the calendar lunations of those months respectively, to contain 30 and 29 days; for Easter, according to the usage of the western churches of the Roman empire, sanctioned by the Council of Nice, must be celebrated on a Sunday, which Sunday must *follow* the 14th day of the Paschal Moon, so that whenever the Paschal 14th, or *Term* fell on Sunday, Easter could not arrive until the *next Sunday*. If the Term fell on Saturday, Easter came *one* day after that Saturday, viz., on the *next day;* consequently the interval between the Paschal Term and Easter might be 7 days, but could never be less than one day: and since the *Term* could not happen before the Calendar-Vernal Equinox, (which, whatever might be the astronomical fact, was, by the Church, invariably fixed on the 21st of March,) Easter Sunday, it is clear, must have its place between the 22d of March and the 25th of April, both days inclusive.

Now supposing the 14th day of the Paschal Moon to coincide with the Calendar Equinox, that moon must have been new, or *in its first day* on the 8th of March, (for 21 *less* 13, is 8,) and the preceding moon must have been 23 days old on the 1st of March, just a week earlier, (for 8 *less* 7, equals 1.) That is to say, the moon on the 1st day of March, must have been of exactly the same age as it was on the 1st of January; the interval between those days in common years, being two lunations, (one of 30, the other of 29 days,) or 59 days in all. The Epacts belonging to January and March are, of course, identical, as they are seen to be in every *Epact Almanac:* and it is manifest that when the Calendar-Moon's age on the first day of the year, exceeds 23 days, (in which case the new moon of March would happen before the 8th, and its 14th day, consequently, before the Equinox,) the *Paschal New Moon* will be in April, and when 23 or less, will happen in March.

If, then, the Paschal Term occurs on the 21st of March, the Annual Epact is 23
if on the 22d " it is 22
if on the 23d " it is 21
and so on, up . . . to the 31st " and down to the Epact 13,
the day of the month rising by *one*, as regularly as the Epact descends by *one*, so that their sum is always the same, ... viz. 44,
and the Paschal Term in March must, of course, be that number *less* the Epact.

Advancing with the Day of the Month to the 1st of April, we descend to the Epact 12
to the 2d " to 11
to the 3d " to 10
and so on, up . . . . to the 12th " and down to the Epact 1,
the sum being always 13,
and the Paschal Term in that part of April which precedes the 13th, is 13 *less* the Epact.

Arriving, in like manner, at the 13th of April, we have the Epact 0, or 30
at the 14th " 29
at the 15th " 28
and so on, up . . . . to the 18th " and down to the Epact 25,
the sum being always 43,
and the Paschal Term for the rest of April is 43 (or 30 + 13) *less* the Epact; subject, however, to two exceptions in the case of the *double Epacts* (25′-26, and 25-24.)*

The Gregorian Calendar of Epacts (see Table III., Encyclop. Brit., Art. "Calendar,") has been so constructed, that the Epact 25 belongs, whenever the Golden Number exceeds 11, to the same day with the Epact 26, and is then marked with an accent, to distinguish it. Now since 43, *less* 26, gives the 17th day of April as the proper Paschal Term or limit; 25′ in order to produce the same result, must be subtracted from 42.

By a like contrivance, the Epact 25 (not accented) belongs, when the Golden Number does not exceed 11, to the same day with the Epact 24; and since 43, *less* 25, yields the 18th of April as the proper Paschal Term or Limit; 24, in order to produce the same result, must likewise be subtracted from . . . 42.

In this manner both the exceptions are readily provided for, with a single diminuend (42.)

* This artifice, employed in the construction of the Table of Gregorian Epacts, by making the age of the moon to differ, occasionally, a day more from the truth, than it would otherwise have done, preserves between the Old and New Calendars, a certain conventional resemblance, which consists in the non-repetition of a given annual epact within the same lunar cycle. For the reason of this arbitrary mode of writing the epacts, and of varying, consequently, the Paschal Term, I must refer to regular treatises on the subject, remarking only that this device of Clavius, to which I have adjusted the *operation* of my own, does by no means prevent, in either style, *Easter Sunday* from falling, repeatedly, in the course of any single cycle of 19 years, *twice*, and sometimes *thrice*, on the same day of the month. In the last lunar cycle, for instance, ending with 1843, the New Style Easter occurred *thrice* on the 3d day of April, and in duplicate four times, on other days of the month. In the present cycle, ending in 1862, like duplicate Easters, on certain days of the month, will happen six times. In the course of the very first cycle of the reform at Rome, similar coincidences took place three times in New Style, and would have done so seven times in Old Style, if the Julian mode of reckoning had not been abandoned.

The Golden Number, being the remainder after division by 19 of the year *plus* 1, the excess of 10, where *the year itself* is to be divided by 19, agreeably to my rule, becomes an equivalent expression for the excess of 11 in the tables referred to.

It will be perceived that the Gregorian Epacts in Table D of my Tablet, are merely arranged in sets or sequences in a more orderly manner, beginning at 1 and ending at 30, than they presented themselves in the course of the foregoing explanations, and that the short column of four numbers, from which they are, according to their several places in the series, to be deducted, namely 13, 44, 43, and 42, assumes, at the same time, greater symmetry.

The difference between those numbers and the Epact can never, in April, exceed 18, but whenever the 14th day of the Paschal Moon falls on the 18th day of that month, and happens at the same time to be Sunday, Easter Sunday must be a week later, or the 25th of April. It must always be at least one day after the Paschal Term, but whether it is to be celebrated *one* or *seven*, or any intermediate number of days after that *term*, will always be correctly determined, when the day of the week on which the term occurs has been found by the Civil Calendar. It is obvious that the number of days to be counted forwards, must be the difference between 8 and the number which indicates the day of the week.

Before the close of the past year, I had prepared, in manuscript, a specimen of the Perpetual Calendar described in the foregoing pages, and had solved, by means of it, numerous chronological questions, trying uniformly the correctness of my results by the tables and formulæ of Lord Macclesfield and Mr. Galloway, when I learned from the Journal of the Franklin Institute, for November, that the next British Almanac and Companion would contain an Article from the pen of Mr. Augustus De Morgan, of University College, London, on the subject of a controversy not unlikely to arise, respecting the proper day of celebrating Easter in 1845. My rules gave me, as the Tablet shows, the 23d of March; but being naturally desirous of testing their accuracy, in that as well as other instances, by such distinguished mathematical authority, I awaited the receipt of a copy of that instructive Annual, which a friend had ordered from England, and which he kindly placed in my hands in the course of the winter. As it embraced, what I had anticipated, a very learned, interesting, full, and satisfactory Essay "on the Ecclesiastical Calendar," I could not but be highly gratified at finding my rules confirmed by every example therein computed, and more especially by the discovery that, owing to the *mechanism* of my Tablet, which spared me the labour of several arithmetical steps, which Mr. De Morgan, (who proposed to himself, and has ably executed, the more difficult task of pure calculation according to Delambre's analytical formulæ, and independent of all tabulation,) had been compelled, under the assigned limits of his problem, to take, I was enabled to attain, in much less time, by rules occupying less space, and requiring less mental and manual effort, the same results with those yielded by his fifteen "short arithmetical directions," given at pages 15 and 16. It appeared to me, besides, that the risk of error was considerably lessened in my process, by the operation's consisting, for the most part, either of the mere *setting down*, or of the *addition* of figures, these figures being.

in two of the items, equations obtained at a single inspection, and, in three other items, *the year itself*. It is for others, however, to decide, (and I should most cheerfully submit the question to the two above-named eminent living authorities, on whom I have relied,) whether the Tablet, which I now present to the Society as a *new* "*method*," professing only to combine very *condensed tables* with *plain rules*, may not possess a sufficient degree of practical utility to deserve publication.

Intent upon rendering the Tablet useful in calculations relating principally to the New Style, I should not have thought of embracing in it the ancient Church Calendar, now gone into disuse in almost every part of the Christian world, except the empire of Russia, had I not met with the "very simple Table" given by Mr. De Morgan, at page 32, and which he says "will supply the place of all rules *as soon as the Golden Number and Dominical Letter are known*." Now, since it has been steadily my aim to eliminate both those portions of the scaffolding of the Calendar, my work seemed incomplete unless I could still dispense with them, and could devise some other means, at least as easy in practice as the ten rules placed by Mr. De Morgan on the subsequent page, for determining the Old Style Easter.

I sought in vain for a copy of Clavius in the public libraries of the United States,* but was fortunate enough to find, in the Library of this Society, "The Art of Verifying Dates," (L'Art de vérifier les dates, troisième édition, par un religieux Bénédictin de la congrégation de St. Maur, Tome premier, à Paris, 1783,) whose very extensive Tables assisted greatly the accomplishment of my object. The "Chronological Table," and the "Perpetual Lunar Calendar," both clearly exhibit the same constant concurrence between the Paschal 14th of the Moon, and the place of the year in the cycle of 19, which is mentioned by Mr. De Morgan, and shown in his Table. We have therefore only to translate into their corresponding Epacts, the several Golden Numbers, in the order in which they there stand, and we shall obtain a series of 19 Julian Epacts, descending while the days of the month rise, as we before witnessed in the case of the Gregorian Calendar; with this difference in the exposition, that blanks are left at each of the ten places between the 21st of March and the 18th of April, where there is no golden number, and where there can be no Epact, since the numbers wanting to complete a regular series (viz., 13, 10, 8, 5, 2, 30, 27, 24, 21 and 19, as well as 16,) had no existence as Epacts in the Ancient Calendar. The Epact 29, forms a case by itself, on account of the peculiar interval of 12 *between* it and the *succeeding* Epact 11. In the Reformed Calendar the interval of 12 always *precedes* the Epact, belonging to every year which is a multiple of 19. But if the Julian XXIX. be treated like the Gregorian 0, or XXX., and be made to change places with 30, it ceases to appear anomalous.

Compare the following columns with those at page 117 of this memoir. The leading Epact there was 23, and is here 15.

* There is one, I have since learned, in the Library of Harvard University, at Cambridge, Massachusetts.

Golden Numbers.	Paschal Term.	Epacts.	Sum of Paschal Term and Epact.
16	March 21	15	
5	22	14	
.	.	.	
13	24	12	
2	25	11	
.	.	.	36
10	27	9	
.	.	.	
18	29	7	
7	30	6	
.	.	.	
15	April 1	4	
4	2	3	
.	.	.	5
12	4	1	
1	5, 0 or 29		34
.	.	.	
9	7	28	
.	.	.	
17	9	26	
6	10	25	
.	.	.	
14	12	23	35
3	13	22	
.	.	.	
11	15	20	
.	.	.	
19	17	18	
8	18	17	

These Epacts, on being re-arranged, in Table D, as the Gregorian were, produce a like symmetry in the column of Numbers 5, 36, 35, 34, from which they are to be deducted, and these numbers differ throughout, by exactly 8, from those which occupy the Gregorian column. The Golden Numbers, too, beginning with 16 and ending with 8, advance regularly by 8, rejecting 19 whenever the addition of 8 to the preceding Golden Number would make the next exceed 19: or, what comes to the same thing, entering line *c* in Table II., (Encyclop. Brit., Art. "Calendar,") and beginning at Epact 15, proceed always from the left to the right, as in a circle, with intervals of 8 places, leaping backwards from the end to the beginning of the line as often as may be necessary, and the whole of the succeeding Julian Epacts, which I have just presented, down to 17, will come regularly into view. The unit's figure of each Epact, except 29, is *one* behind the unit's figure of each Golden number, thus exemplifying a passing observation made at page 114, line 5th.

These curious relations between the Reformed and Ancient Calendar would perhaps be more strongly impressed upon the memory, if exhibited together, in the following form:

		To obtain the Paschal Term		
Take any Gregorian annual Epact			Take any Julian annual Epact	
below 13	from . . . 13,	*in April*	below 5	from 5,
between 13 & 23	from 13 + 31 = 44,	*in March*	between 5 & 15	from 5 + 31 = 36,
above 23	from 13 + 30 = 43;	*in April*	above 15	from 5 + 30 = 35;
But take 24 & 25	from 13 + 29 = 42.	*in April*	*But* take 29	from 5 + 29 = 31.

The memory might be technically aided by adverting to the fact, that 31, 30, and 29 days, are the *length* of Civil months in all Leap Years, as well as that of artificial Lunations in the existing Church Calendar; and that the 13th and 5th were the days of the month on which the Ides and Nones, in every month but four, of the old Roman Calendar began.

It is of more importance, however, to state, that, having procured, in April last, through the politeness of Professor E. Otis Kendall, from the Library of the High School of Philadelphia, the use of Delambre's History of Modern Astronomy, I have, since then, calculated, according to my Tablet, every example given in Book I., "on the reformation of the Calendar," (including the extreme cases put by Delambre, to illustrate his principles, in the controversy with Ciccolini, about the relative merits of their respective formulæ.) and that I have found my results not only to correspond uniformly with those which are there computed, but to be reached much more expeditiously also, than by the processes there employed.

I have, moreover, been prompted by curiosity, as well as by caution, to extend my secular corrections as far as Delambre had pursued his, in the Connoissance des Tems, for 1817, and to carry down, accordingly, with the mechanism of the asterisks, my equations in Columns A and C, to the 500th century. I compared, as I proceeded, a few cases, at various epochs, and many, near the termination of my task, with the answers contained in his beautiful "Table Pascale," at page 43, Book I. (Astron. Moderne.) where the Gregorian Easters are obtained by inspection after the Dominical Letter and Epact are known; and I had the pleasure to find, in every instance, the results still identical.

Without doubting for a moment, or presuming to call in question, the correctness of the principles on which that Paschal Table has been constructed, I feel it, nevertheless, incumbent on me to remark, that, from the text of Delambre, at page 24, it would appear that Clavius's Great Table, which is almost universally consulted as a standard, differs from Delambre's small one, by including, among the years in which Easter happens on the 22d of *March*, the year 3860. According to Delambre's formulæ and Paschal Table, (the Dominical Letter being G, and the Epact 24,) it will fall on the 22d of *April;* according to Gauss's formula, (M being 2 and N being 5,) on the same day; by the tables of Lord Macclesfield and Mr. Galloway, (the Golden Number being 4, and the Dominical Letter G,) on the same day; and, finally, by Mr. De Morgan's Rules, and by my own, on the same day, that is, on the 22d of April. With such a preponderance of concurrent testimony in favour of the conclusion at which I arrive, I cannot but suppose that Clavius

must either be in error, or that the *month* has been, by some inadvertence, misquoted from his Table by Delambre. The day (or quantième) of the month is the same, according to all the mathematicians thus far named, and the *month* must be April, for the 22d of March corresponds with Thursday, and not with Sunday, in that year, and the Paschal New Moon cannot happen in March when the Epact exceeds 23. It seems no less unaccountable, that Sir Harris Nicolas, who gratefully acknowledges some assistance from Mr. De Morgan, when preparing his "Chronology of History," published in 1833, in Lardner's Cabinet Cyclopedia, should make the Easter of 3860, by the NUMBER OF DIRECTION in his Table II, to be the 15th of April,—just a week earlier than my instructors have computed it, and yet not agreeing with Clavius's decision, as before reported. I shall be glad if the pointing out of this strange discrepancy should lead to the removal of a radical error existing *somewhere*, and, as I believe, in Vince's Complete System of Astronomy, vol. 1, page 581, in Ferguson's Astronomy, and in Rees's Cyclopedia, (Article "Cycle,") in all of which, as well as in many other scientific and popular works of reference, a like Table, containing numbers of *Direction*, (so called,) said to be "adapted to the New Style," is given, but in terms unsanctioned by those later and abler *Analysts* whom I have consulted, and on whose principles I have relied. Certain it is, that Sir H. Nicolas's Tables, H and K, (pages 57 and 58, Edition II.,) are entirely at variance with each other in regard to the Easter day of every year having the Golden Number 14, (or Epact 24,) between 1590 and 1685, both inclusive; and it is equally true that Delambre's formulæ do not authenticate the Easters of any year having the Golden Number 4, (or Epact 24,) from 3803 to 3898, both inclusive, as calculated by Sir H. Nicolas's Table II. In these last cases the deviation varies from one to two weeks; in the former, it amounts always to four weeks.

The learned Benedictine of St. Maur, who, between the first and third edition of "The Art of Verifying Dates," discovered the means of reducing his "Perpetual Solar Calendar" from 210 folio pages, which he had confessed to be *rather* voluminous, to its present bulk of 42, makes the following truly philosophical reflection: "Tel est le sort des inventions humaines, de n' être perfectionnées que par degrés, et presque jamais du premier coup." Then, after explaining by what expedients he had accomplished so important an abridgment, he congratulates himself and the public on his great success, and finishes, by saying: "Il est simple, il est court." On examining his work, it will be evident, that 64 of his pages are essentially replaced by the single one forming my Tablet, which may, consequently, with more truth be characterised as "simple and short," without being found, I trust, the less sure.*

* N. B.—The words "*in Julian Years*," standing at the close of the Exception to the General Rule for finding the Epact, were inadvertently omitted in the Tablet, as printed in the Quarterly Proceedings of 1845. This *Erratum*, (for the exception was not meant to be applied to Gregorian Years,) grew out of a change made by me, with a view to brevity, but without due care, in the terms of the original manuscript, which directed "that every *zero* resulting from the division of the sum by 30 should be called XXX. in New Style, but XXIX. in Old,"—a restriction exactly equivalent to the one here prescribed, and *that* by which all the computations connected with my device were really governed.

The facility of this method arises principally from the Gregorian Secular Equations, in Columns A and C, being *mechanically* formed and tabulated. To obtain the same corrections, *arithmetically*, no simpler rules than the following could perhaps be devised; and a comparison of the two processes will therefore exhibit fairly the economy of time and trouble which the Tablet effects, apart from what is saved by using Table B.

Rule for finding, universally, the New Style Solar Equation of Column A.

Divide the Centurial figures by 8, and the Remainder by 4.
From the sum of the two Quotients (increased, if needful, by 7,) deduct the Remainder.
The Difference (rejecting the sevens, if any,) will be the Equation wanted.
(But since the final rejection of the sevens, is provided for by the Rule of the Tablet, the Difference itself will answer every purpose of that Equation.)

Rules for finding the New Style Lunisolar Equation of Column C, until A. D. 1899 *inclusive.*

Divide the Centurial figures by both 3 and 4, and to the two Quotients add 8.
From the Sum deduct the Centurial figures, the Difference will be the Equation wanted.

From A. D. 1899 *to* A. D. 4199, *both inclusive.*

Divide the Centurial figures by both 3 and 4, and to the two Quotients add 8.
From the Centurial figures deduct the Sum: Then take the Difference from the next higher multiple of 30 (which, during this period, is always 30,) and the Second Difference will be the Equation wanted.

At and after A. D. 4200 *for ever.*

The rule is the same as the last, with this Exception only, viz.
that the Centurial figures must be diminished by $\left(\frac{C-17}{25}\right)_w = \left(\frac{4\,C-68}{100}\right)_w$,
that is to say, by the Quotient arising from the division of "four times the Centurial figures" *less* 68, by 100, before being divided by 3: but they must be used, in the rest of the work, exactly in the manner there directed.

The following results of the Rule and Tablet will be found in perfect accordance with those derived from Delambre's formulæ and Paschal Table, in determining Easter for A. D. 50000.

The Solar Equation of Column A = 3; and Lunisolar Equation of Column C = 3.
The Dominical Letters are *B* and *A*, and the Epact is 4.
The 14th day of the Paschal Moon will fall on Sunday, the 9th of April, and Easter, of course, on the following Sunday, viz., the 16th of April.

A collateral proof of the correctness of these secular equations is derived from the fact, lately observed by me, that the same mechanical expedient of the asterisks furnishes, instantly, all the Gregorian Corrections M and N of Gauss's formula, beginning with 22 and 2, but in advancing series (the reverse of mine) as given by M. Le Chevalier de Grésy, in Vol. XXIV., page 77, of the Memoirs of the Royal Academy of Turin.

SUPPLEMENT TO MR. McILVAINE'S MEMOIR.

Read December 18th, 1846.

When constructing the "New Perpetual Calendar," which I had the honour of presenting to the Society, last year, I purposely avoided furnishing any rule for the Era before Christ, lest the requisite explanations in regard to leap years, (which, for that period, are so expressed by chronologists, as never to be multiples of 4,) might unduly extend or complicate the Tablet. Since its publication, however, in the Quarterly Bulletin, where it appears in a reduced form, with the Examples conveniently separated from the Rules, I have been led to believe that, without exceeding the limits of a single page, in the next volume of the Transactions, at large, the 1st of the annexed Supplemental Rules might readily be subjoined to it, and thus render the plan applicable to *all Time*.

The Rule is a mere corollary from the general principles of the Tablet; for after A. D. 1, the numbers of the two series 1, 29, 57, &c., and 1, 20, 39, &c., (see pages 109 and 113) never again *coincide* until A. D. 533, 1065, 1597, &c., each of which years, like A. D. 1, is the first after leap year, begins and ends on Sat., and has the same Epact, 11. Reversing the order of time, the chronol. year 1, B. C., or astron. year 0, is the 28th of the Solar, and 19th of the Lunar, cycle, next preceding A. D. 1. It is a leap year, begins on Th., ends on F., has the Epact 29, and corresponds with A. D. 532. The chronol. year 2, B. C., or the astron. year 1, is the 27th of the Solar, and 18th of the Lunar Cycle, next preceding A. D. 1. It is the third after leap year, begins and ends on W., has the Epact 18, and corresponds with A. D. 531; and so *backwards* without limit, through all the combinations of Old Style cycles concurring at regular intervals of 532 *entire* years.

I have added a convenient Rule, the 2d, for years of the Julian Period; a 3d Rule, with formulæ, to serve as proofs; also, a simple method, Rule 4th, of solving *converse* problems, which, though more curious, perhaps, than useful, I beg leave to append to the memoir.

I was recently much gratified by learning from Mr. Galloway and Mr. De Morgan, who have, at my request, had the goodness to consult for me the fifth volume of Clavius's mathematical works, and to furnish me with a few particulars from the explication there given of the Reformed Roman Calendar, that my conjecture respecting the discrepancy, in a single case, between my results and those *set down* in the great Table of Clavius, as well as in the text of Delambre, turns out to be correct. On tracing the difference to its source, it appears that the Table and the text are alike *erroneous*, but accidentally so.

The substance of the communications with which I have been honoured on the point in question, is this. In the Table there is an "*obvious misprint*," at the angle where the line belonging to the year 3860 meets the column of Easters; in which column the months of March and April are not otherwise distinguished than by their initial letters M and A. The Easter for that year "stands 22 M, but ought to be 22 A;" for, in the same line, and in nearly adjoining columns on the left, the Paschal full moon is made to fall "18^{d} 18^{h} A," the Paschal 14th is made "18 A," and all the moveable feasts *accord* with those of an Easter that occurs on the 22d day of April. Moreover, in the column immediately on the right stands "Pentecost 10 June," which is absurd, when Easter is any where in March, and renders the fact more strange that Delambre should have "*missed seeing the error*."

SUPPLEMENTAL RULES

EXTENDING AND FACILITATING THE USE OF THE FOREGOING TABLET.

1st. A Rule for Julian Years before Christ, back to the remotest Epoch.

From any multiple of 532, preferring the multiple next greater than the given Year, Subtract the given Year B. C. less 1, (but the year itself, if denoted astronomically.) The Difference will be a Julian Year *after* Christ holding a *corresponding* place with it in the *Dionysian Period*, (or product of the solar cycle of 28, by the lunar cycle of 19 years,) Then the foregoing Rules applied to the Year *after Christ*, thus found, must yield both the Days of the Week and the Epact, correctly, for the given Year *before* Christ. If the year *after* Christ be a multiple of 4, the year *before* Christ, (though an odd number) is also a leap year.

EXAMPLES.

What day of the week was May the 28th in the 585th Year B. C., Old Style?

532 × 2 = 1064
585 — 1 = 581

Difference	480	or like year *after* Christ.
One fourth part,	120	
Eq. in column A	5	
No. for May, Table B	1	
Day of Month	28	
Divide by	7) 634	
Remainder	4	or Wednesday.

(See Article "Cycle," in Rees's Cyclopedia.) It is a *Leap* Year, and its Epact will be found, by the Tablet, to be 25.

What day of the week was January the 1st, in the Year 6857, B. C.? (reckoned astronomically.)

532 × 13 = 6916
6857

Difference	59	or like year *after* Christ.
One fourth part	14	
Eq. in column A	5	
No. for Jan., Table B	0	
Day of the Month	1	
Divide by	7) 79	
Remainder	2	or Monday.

See Delambre, who says "*that* year *begins* and *ends* on Monday." It is, of course, *common*, and its Epact will be found to be 22.

2d. A Rule for Years of the Julian Period, or (A. J. P.,) both before and after Christ.

{4714 less the Chronological Year B. C. / 4713 less the Astronomical Year B. C. / 1713 added to the Year of Christ A. D.} = the Year of the Julian Period (or A. J. P.)

To A. J. P. add 19, or from A. J. P. deduct 9 / To A. J. P. add 18, or from A. J. P. deduct 1 } and to the *Sum* or *Difference*, as if it were a Julian A. D.,

Apply {the Civil Rule / the Church Rule} of the Tablet for finding {the Day of the Week, or Feria. / the age of the Moon, or Epact.}

The Sum, or Difference *lessened* by any multiple of 532 (such as 3724) yields the same answers.

EXAMPLES.

A. J. P. 3938	July 1st,	year B. C.	776	Chronological Epoch of the Olympiads,		Feria 2	or Monday,	Epact 14.
3961	April 21,	"	753	"	"	Rome	" 2	Monday, " 28
3967	Feb. 26,	"	747	"	"	Nabonassar	" 4	Wednes'y, " 4
4104	Sept. 30,	"	610	Eclipse predicted by Thales (F. Baily)			" 6	Friday, " 18
4129	May 28,	"	585	Eclipse Art. "Cycle," Rees's Cyclop.			" 4	Wednes'y, " 25
4669	Jan. 1,	"	45	Reform. Cal. of Jul. Cæsar (bissextile)			" 6	Friday, " 23
4713	Jan. 1,	"	1, or Year 0 of Astronomers			(bissextile)	" 5	Thursday, " 29
5335	July 16,	A. D.	622	Epoch of the Hegira			" 6	Friday, " 4

Ex. first, A. J. P. 3938 + {19 = 3957 A. D. / 18 = 3956 A. D.} And {3957 / 3956} — 3724 (or 532 × 7) = {233 A. D. / 232 A. D.} Results as above.

A. J. P. 3938 — {9 = 3929 A. D. / 1 = 3937 A. D.} And {3929 / 3937} — 3724 (or 532 × 7) = {205 A. D. / 213 A. D.} Results as above.

3*d Rule.* As a means of *proving* all the foregoing operations, or *in lieu* of them, with a view, chiefly, to save figures in computing the Epact, EMPLOY the following formulæ, which do not refer either to the cycle of the sun, or to that of the Golden Numbers, now in common use, beginning with the year 1 + 9, and the year 1 + 1, respectively, but to a succession of cycles of 28 and 19, in which the years corresponding with the *first* year of the Christian Era must always be numbered the *first* of each cycle also.

FORMULÆ.

Call any astronomical year *before Christ*, y and any A. D., or year *after Christ*, Y } and their Remainder after division by either cycle, r

If $r = 0$, keep it so; except in Old Style Years, when, if 19 be the Divisor, change 0 to 19.

Then $28 - \left(\frac{y}{28}\right)_r$, and $19 - \left(\frac{y}{19}\right)_r$, will express y's No. in each cycle in the Era B. C.

And $\left(\frac{Y}{28}\right)_r$, and $\left(\frac{Y}{19}\right)_r$, will express Y's No. in each cycle in the Era *after Christ*.

Apply the RULES of the Tablet, on each side, to the Cyclic No. thus found, as if it were the given year, using always the secular equations A and C, belonging to the given ERA, and the results will be uniformly the same, as in the examples heretofore stated.

When the Cyclic No. on the Civil side is a multiple of 4, the year is leap, unless it be a New Style 100th year unmarked with an asterisk.

When the Cyclic No. on the Church side is 19, "1 less than the 19th part" becomes 0, and the Exception to the Rule for finding the Epact is thus eliminated.

EXAMPLES.

1. *Required both the Old and New Style Easter of A. D.* 1848, (*being a multiple of* 28.)

Julian Year.		Easter.	
28) 1848		19) 1848	
Remainder	0	Remainder	5
its 4th	0	5 × 10 =	50
A	5	C	0
Month	6	30)	55
Day	10	Epact	25
7) 21 Rem.		From	35
Saturday, 0 or 7		Term April	10
From	8		
1	to Sunday		1
	Answer, April		11

Gregorian Year.		Easter.	
28) 1848		19) 1848	
Remainder	0	Remainder	5
its 4th	0	5 × 10 =	50
A	0	C	0
Month	6	30)	55
Day	18	Epact	25
7) 24 Rem.		From	43
Tuesday	3	Term April	18
From	8		
5	to Sunday		5
	Answer, April		23

2. *Required both the Old and New Style Easter of A. D.* 2698, (*being a multiple of* 19.)

Julian Year.		Easter.	
28) 2698		19) 2698	
Remainder	10	Remainder 0 =	
its 4th	2	Divisor	19
A	5	19 × 10 =	190
Month	6	C	0
Day	5	30)	209
7) 28 Rem.		Epact	29
Saturday 0 or 7		From	34
From	8	Term April	5
1	to Sunday,		1
	Answer, April		6

Gregorian Year.		Easter.	
28) 2698		19) 2698	
Remainder	10	Remainder 0 (kept 0)	
its 4th	2	0 × 10 =	0
A	1	C	26
Month	6	30)	26
Day	17		
7) 36 Rem.		Epact	26
Sunday	1	From	43
From	8	Term April	17
7	to Sunday		7
	Answer, April		24

In the first example, the difference between the styles is 12 days, and in the second, it is 18 days. It so happens, therefore, that, in both these cases, the Julian and Gregorian Easters will be celebrated on the very same day. The year 2698 is the last, according to Mr. De Morgan, in which such a coincidence will occur. See note at the foot of page 19, in his Essay on the Ecclesiastical Calendar. See also page 105 of this Memoir.

The Rule for the Gregorian Epact, it will be perceived, becomes universally the following,

To 11 *times the Cyclic No. add the Equation in Column C; and reject* 30*s from the Sum.*

The Rule for the Feria, (or day of the week,) though not attended with an equal economy of Figures, suggests the practical convenience of marking for remembrance, in any current century, those years which terminate cycles of 28, (such as 1820, 1848, and 1876, in the present century,) in which case the Cyclic No. for any intermediate year, may be promptly known, and the day of the week be thence deduced by an easy *mental* process. For instance, the Cyclic No. for 1847 is 27, (or 27 years beyond 1820,) and the other figures to be added to it are so few and small, that ordinary questions may be solved by the Rule without putting pen to paper, more especially in the present century, whose secular equations are, on both sides of the Tablet, null until 1900.

A similar expedient might be adopted with the years 1805, 1824, 1843, 1862, 1881, each ending cycles of 19, and the Epacts for intermediate years be *mentally* computed with like facility. Thus the Cyclic No. for 1847 is 4, (or four years beyond 1843,) and the Epact is 14, or 4 times 11 *lessened* by 30.

Without departing, however, from the original form of the Tablet, the work may be somewhat abbreviated by noting those years only which close at once, centuries and cycles, (such as 1400, 1800, &c., on one side, and 1900, 3800, &c., on the other.) and by using, in computation, the years beyond those epochs respectively. Thus 447, 448, &c., yield the same feriæ as A. D. 1847, 1848, &c.; and, in the coming century, 1, 2, 3, &c., will yield the same Epacts as A. D. 1901, 1902, &c.

4th. A Rule for the Solution, by the foregoing Tablet, of Converse Questions, viz.,

To find on what day of the *Month* a given Day of the *Week* first falls in any *Month* in any year. Omit the day of the Month in the fifth line, and divide the Sum of the four other lines by 7; Subtract the Remainder from the numerical *Day of the Week*, increased, if needful, by 7, The Difference will be the Answer. But in January and February of Leap Year take the Remainder from the *succeeding* day of the Week, increased, if needful, in like manner.

EXAMPLES.

What Day of the Month was the first Monday in Dec. 1846, the day of the meeting of Congress?

The Remainder, by the above Rule, will be . . . 2
Monday 2 — 2 = 0: Increase, therefore, the day by 7.
Then 9 — 2 = 7. Answer, December the 7th.
Proof—The Tablet shows that the month began on Tu.

What Day of the Month was the first Thursday in Feb., 1844? (being a Leap Year.)

The Remainder by the above Rule, will be 5
5 taken from 6, (Friday) leaves for the answer 1
or the *first* day of that Month.
See De Morgan's Essay, page 16, Example 2d.

Note.—Any reference, in Leap Years, either to *preceding* or *succeeding* Days of the Week in January and February may be avoided by substituting the Monthly No. of July for January, and that of August for February, each No. being half a year distant from that which it takes the place of.

In the last example, for instance, had the August No. 2 been used instead of the February No. 3, the Remainder would have been 4, which taken from Thursday, or 5, would have given the same result.

APPENDIX TO MR. McILVAINE'S MEMOIR.

Read July 16th, 1847.

I beg the Society's acceptance of the accompanying Cards, containing a new plan of a Perpetual *Civil* Calendar, &c., in which, still dispensing with Dominical Letters, and substituting for them Yearly Numbers, (always their *complement* to 8, if we read 0 as equal to 7,) the same results may be obtained by mere *inspection*, as those requiring computation according to the scheme heretofore presented by me. The equivalence of the two methods will be readily recognised by the following comparison of them, which is universally applicable.

The Yearly Number, by the former plan, would be the Remainder on division by 7 of the Sum of the Year, its fourth part (omitting fractions,) and the secular Equation in Column A; which Remainder, for the New Style year 1847, after Christ, is 5, the same as the Yearly Number here standing in Table C, at the intersection of the *line* of A with the *column* of B. The same line (be it observed) answers for a whole century.

Now for the names of the months of Table E in this plan, substitute the Monthly Numbers 0, 1, 2, 3, 4, 5, 6, of Table B in the former, and the two processes become virtually identical, thus:

The 18th of June, 1847, found by the former, would be $\left(\frac{5+4+18}{7}\right)_r = \left(\frac{27}{7}\right)_r = 6$ or Friday.

By the present, counting 5 onwards from 18 in Table C, we reach a column containing 23; then descending the *column* to Table E, we find in the *line* of June the Day of the Week to be Friday, corresponding with the Remainder 6. If, in the blank space between the Examples and Table E, and in line with the respective months, their seven monthly numbers were so arranged as to form a short column, it would, perhaps, be more clearly seen how and why, the relative position of the several Tables of page 129 effects the same object as the Rule on the Civil side of the Perpetual Calendar, at page 106.

I have given no examples of *New Style* years, either before the Christian Era, or between it and the year 1582, because that mode of reckoning, though well calculated to reveal, and to measure approximately, the chief defect of the Julian Calendar, is not customary in chronology, and, being somewhat speculative, might perplex, rather than assist an inquirer; but, in Old Style years before Christ, and in New Style years until the Gregorian reckoning shall be modified, the wide range of these five Tables may be very satisfactorily shown by two of the examples which have been already worked in a different manner, namely the 1st of January, in the astronomical year 6857, B. C., at page 125, and the 16th of April, A. D 50000, at page 123. Both their centurial figures lie beyond the limits of Table A; but 68, yielding, on division by 7, the Remainder 5, belongs to the same line with 5, O.S. B.C.; and 500, yielding, on division by 4, the Remainder 0, belongs to the same line with 16, N.S. A.C. The Yearly Number in the first case, (using, agreeably to the 2d Exception, 43 instead of 57, in Table B,) is 1, and the answer is Monday. The Yearly Number, in the second case, is 0, and the answer is Sunday.

This device is accordingly verified by the formulæ of Delambre to the same extent as the one from which it has been drawn; and I solicit permission to occupy, with a copy of it, an additional page of the Transactions.

NEW PLAN OF A PERPETUAL CIVIL CALENDAR, JULIAN AND GREGORIAN,

SHOWING, BY INSPECTION,

THE AGREEMENT OF *MONTHLY DATES* WITH *DAYS OF THE WEEK* IN ANY *YEAR* BEFORE OR AFTER THE CHRISTIAN ERA.

USE OF THE TABLES A, B, C, D, E.

Given the *monthly date* to find *the day of the week.*

1. In A look for the *horizontal line* containing the CENTURIAL FIGURES, and In B for the *vertical column* containing the remaining PART OF A CENTURY, In C, where line and col. *meet*, is the YEARLY NUMBER, which keep in mind.
2. In D look for the DAY OF THE MONTH, from which *day*, (but exclusive of it,) count onwards *as many days as the* YEARLY NUMBER, you have just noted. Then going down the *column* you have reached to the *line* of the MONTH in E, you will find, where they *meet*, the DAY OF THE WEEK sought.

EXCEPTIONS.

1. In Leap Years *use* the line of { JULY for JAN. (the bottom line for the top,) / AUG. for FEB. (the line next above FEB.)
2. In the Era B. C. *use* the *complement* to 100 of the *given* PART OF A CENTURY, and, consequently, for centesimal years, *use* the column marked •00, at the foot of B, instead of the column marked •0 at the head of that Table.

NOTE.—ASTRONOMICAL years B. C., are always 1 *less* than CHRONOLOGICAL, and must be so denoted. Thus the chronological years 1, 2, 3, &c. are the same as the astronomical years . . . . 0, 1, 2, &c.

A

WHOLE CENTURIAL FIGURES.

BEFORE CHRIST. ASTRONOMICAL.						AFTER CHRIST.						
New Style.			*Old Style.*			*Old Style.*			*New Style.*					
10	6	2	20	13	6	0	7	14	17	21	25	29	33	37
			19	12	5	1	8	15						
9	5	1	18	11	4	2	9	16	18	22	26	30	34	38
			17	10	3	3	10	17						
•8	•4	•0	16	9	2	4	11	18	15	19	23	27	31	35	39
7	3		15	8	1	5	12	19	•16	•20	•24	•28	•32	•36	•40
			14	7	0	6	13	20						

Any other CENTURIAL FIGURES yielding, on division by 7, in Old Style, and by 4, in New Style, the same *Remainder* as those above do, when so divided, belong to the *same line of the same ERA.*

CONVERSE USE OF THE TABLES.

Given *the day of the week* to find the *monthly dates.*

1. In A, B, and C obtain the YEARLY NUMBER, as you were before directed.
2. In E look for the *line* containing both THE NAME OF THE MONTH and THE DAY OF THE WEEK, from which *day*, (excluding itself,) count backwards *in that line as many days as the* YEARLY NUMBER you have noted. Then going up the *column* you have reached to D, you will find all the *corresponding dates of that* MONTH (four or five,) presented vertically, at one view. But attend to both the EXCEPTIONS as above stated.

EXAMPLES.

	A	B	Comp. to 100	C	D	Sum of C & D	Except first	Ans. E	EPOCHS.
O.S. B.C.	775	25		II.	1 July	3		M.	Olympiads
	752	48		III.	21 Apr.	24		M.	Rome founded.
	746	54		III.	26 Feb.	29		W.	Babylon founded.
	44	•56		VI.	1 Jan.	7	•July	F.	Reformed Cal. of Julius Cæsar.
	0	•00		V.	1 Jan.	6	•July	TH.	Astron. year 0 = Chronolog. 1.
O.S.A.C.	1			VI.	1 Jan.	7		SA.	CHRISTIAN ERA begins.
	622			V.	16 July	21		F.	Hegira.
	1582			I.	5 Oct.	6		F.	Oct. 5th made 15th, N.S. at Rome.
	1732	•		O.	11 Feb.	11	•Aug.	F.	WASHINGTON born.
N.S. A.C.	1732	•		III.	22 Feb.	25	•Aug.	F.	WASHINGTON born.
	1752			O.	14 Sep.	11		TH.	Sep. 3 O.S. made 14th in G. Brit.
	1776			II.	4 July	6		TH	Independence declared by U.S.A.
	1847			V.	6 Dec.	11		M.	Congress meets first M. in Dec.
	1800			III.	1 Jan.	4	com. yr	W.	Centurial figs. 18 have *no* star.

B

PARTS OF A CENTURY. Leap years marked thus •, *but* N. S. 100th years are *not* leap unless the CENT. FIGS. have a •.

				• 0	1	2
3		• 4	5	6	7	
• 8	9	10	11		• 12	13
14	15		• 16	17	18	19
	• 20	21	22	23		• 24
25	26	27		• 28	29	30
31		• 32	33	34	35	
• 36	37	38	39		• 40	41
42	43		• 44	45	46	47
	• 48	49	50	51		• 52
53	54	55		• 56	57	58
59		• 60	61	62	63	
• 64	65	66	67		• 68	69
70	71		• 72	73	74	75
	• 76	77	78	79		• 80
81	82	83		• 84	85	86
87		• 88	89	90	91	
• 92	93	94	95		• 96	97
98	99		• 00			

C

YEARLY NUMBERS.

I.	II.	III.	IV.	V.	VI.	O.
O.	I.	II.	III.	IV.	V.	VI.
VI.	O.	I.	II.	III.	IV.	V.
V.	VI.	O.	I.	II.	III.	IV.
IV.	V.	VI.	O.	I.	II.	III.
III.	IV.	V.	VI.	O.	I.	II.
II.	III.	IV.	V.	VI.	O.	I.

D

DAYS OF THE MONTH.

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	32	33	34	35
36	38	highest Sum of C and D.				

E

MONTH OF	DAYS OF THE WEEK.						
JAN. OCT.	SU.	M.	TU.	W.	TH.	F.	SA.
MAY	M.	TU.	W.	TH.	F.	SA.	SU.
AUG.	TU.	W.	TH.	F.	SA.	SU.	M.
FEB. MAR. NOV.	W.	TH.	F.	SA.	SU.	M.	TU.
JUNE	TH.	F.	SA.	SU.	M.	TU.	W.
SEP. DEC.	F.	SA.	SU.	M.	TU.	W.	TH.
APR. JULY	SA.	SU.	M.	TU.	W.	TH.	F.

ARTICLE VI.

On the Corpus Luteum. By Ch. D. Meigs, M.D., Mem. Am. Phil. Soc., Prof. of Mid. and Diseases of Women and Children in Jefferson Med. Coll. Read January 15th, 1847.

On the 18th of December, 1846, I made a verbal communication to the Society, setting forth certain opinions I had formed as to a vitellary nature of the Corpus Luteum.

I now propose to lay before the Society, in a more formal manner, and in larger detail, the proofs, as I suppose them to be, of my proposition, with certain arguments, to show how a reasoning upon the subject tends to confirm the opinions derived from observation. I request that the present communication may be considered as a repetition and enlargement of the statements I have already made here, on the subject in question.

Since the date referred to I have carefully made researches both with my Chevallier's microscope and by other methods, as to the comparative appearances of vitellary matter taken from the egg, and matter procured from fresh Corpora Lutea.

These renewed researches leave me very fully convinced that the yelk of eggs and the yellow matter found in a corpus luteum, are of the same apparent structure, form, colour, odour, coagulability, and refractive power.

Having placed a small quantity of yelk on the platine, and just before I have brought the object into the focus I have been struck with the appearance of the transmitted light; a bright-yellow, which fills the whole tube of the instrument.

When I have, in like manner, placed a bit of fresh corpus luteum, of the cow or sheep, on the compressor, and have crushed it, by turning the screw, I have found the tube filled with the same tinted light, before obtaining the focus.

A portion of yelk placed beneath the objective, exhibits numerous granules, corpuscles containing a yellow fluid, and oil-globules, mixed with a quantity of punctiform bodies.

Upon turning the screw of the compressor on a small lump of corpus luteum, carefully dissected out from its indusium, there is seen to escape from the crushed mass a quantity of granules, corpuscles filled with yellow fluid, oil-globules, and punctiform bodies swimming in a pellucid liquor.

The appearances observed upon examining a portion of yelk and a portion of corpus luteum are so similar that it would be difficult, I think, to discriminate between them, but for the exception, that along with the vitellary corpuscles and granules and globules of the yellow body, there will be found flocks of laminated cellular tela, blood-discs, and other detritus of the organ, destroyed by the compressor.

The transparent corpuscles transmit a yellow light, whether observed singly, or in clusters, or acervuli.

The same is true of the corpuscles of the yelk.

On crushing a bit of corpus luteum with the compressorium, there escapes much granular matter that accurately resembles the granules of the granular membrane, the proligerous disc or retinacula of the Graafian follicle. This is the case when great precaution has been used in procuring the bit from the outer superficies of the corpus luteum; avoiding to take any portion that might have touched the inner superficies of the crypt left by the escape of the ovulum.

The similarity in the appearance leads me to suppose an identity of nature and origin.

I think no person accustomed to the use of the microscope could detect any difference between the molecules pressed out of a bit of corpus luteum, and those that escape from a crushed mammiferous ovule, or the yelk of an egg, excepting the debris or detritus before mentioned, and which is referrible to the destructive power of the compressorium.

I have so many times examined the mammiferous ovulum that I suppose myself quite competent to compare its contents with those of the corpus luteum, and with common yelk.

I hope I am entitled to say, that the colouring matter and the chief constituent bulk of a corpus luteum, is a true vitellary matter, deposited outside of the inner concentric spherule, or ovisac of the Graafian follicle.

For the proof of the truth of this opinion I refer to the future observations of the micrographers, who will be able to confirm or to confute my statement.

There is not, so far as I know, any author who has taken this view of the constitution of the corpus luteum—though that substance has been the fruitful topic of elaborate research and hypothesis, owing to the interest connected with its being, both in a physiological and medico-legal relation.

Previous to the year 1825, when John Evangelista Purkinje, of Breslau, discovered the germinal vesicle of the unfœcundated egg; to the year 1827, when Ch. Ern. V. Baer detected the mammal ovum, with its germinal vesicle; and the year 1830, when Rudolph Wagner ascertained the existence of the *Keim fleck*, or macula germinativa, all notions and opinions on the mammal ovum may be set down as naught—since the opinions of the learned are now based on the discoveries just mentioned; which have led on a complete revolution in many most important relations of physiological action, and therapeutical indication and treatment.

It would be bootless, therefore, to ask what the writers of an earlier date than 1825, may have supposed upon this subject.

Dr. Carpenter, John Müller, Thomas Schwann, Henle, and Huschke have not hinted at the vitellary nature of the yellow body.

Dr. Henle, in his Algemeine Anatomie, says, so weiss mann namentlich, wie die Gräfschen Bläschen in folge der congestion welche den fruchtbaren beischlaf folgt, erst anschwellen und den platzen, wahrend sie zugleich von Blutt angefüllt werden, welches sie almahlig entfarbt, organisirt, und in eine narbensubstanz verwandelt, die zuleszt verschwindet.—P. 894.

In this paragraph, Dr. Henle attributes the swelling and the bursting of the Graafian follicle to the congestion attending a fœcundation. He says the ruptured cell is filled with blood, which colours it, becomes organized, converted into a scar-like substance, and then, at length, disappears.

Dr. Huschke, in his Treatise on Splanchnology, elaborately details the opinions of authors on the corpus luteum; but no where alludes to the vitellary nature of that body.

Dr. Gendrin, M. Maygrier, Dr. Robert Lee, Wharton Jones, M. Raciborski, Olivier D'Angers, M. Pouchet, make no mention of it—though they all enter into details.

Dr. Montgomery, Dr. Swan, and, I think, Dr. Patterson, speak not of it.

M. Flourens, and M. Velpeau, and Dr. Moreau, omit all allusion to the vitellary structure of the substance.

Bernhardt, who was assisted in the construction of his Symbolæ ad ovi Mam. Hist. ante Prægnationem by Dr. Valentin, and in which admired work is contained a complete deduction of the whole literature of the corpus luteum, alludes not to the idea.

Von Baer's celebrated letter, de Ovi Mam. et Hominis Genesi, says of the corpus luteum, at page 20, Me judice, minime corpus novum est, sed stratum internum thecæ majus evolutum,—which expresses, with sufficient clearness, the opinions set forth in the rest of his paragraph.

Dr. Bischoff, of Heidelberg formerly, now of Geissen, in his Entwickelungsgeschicte der Saugthiere und des Menschen, says, at page 33:

Wenn mann die erste entwickelung des gelben Körpers, unmittelbar nach austritt des eies, bei Thieren beobachtet hat, so kann mann darüber nicht in zweifel seyn, dass die bildung seiner masse von den innern fläche des Graafschens Bläschens ausgeht. Da sie nun hier die aus zellen gebildete *membrana granulosa* befindet, da sie zuerst als gelber Körper erkennbarre masse gleichfalls aus zellen besteht, so ist es wohl gewiss, dass von einer starkeren entwickelung dieser zellen der *membrana granulosa*, die ich auch in der Periphærie des eies noch nachweisen werde, die bildung des gelben Körpers ausgeht.

From this passage, it seems that Dr. Bischoff is not far from discovering what I suppose myself to have discovered; I mean the vitellary nature of the yellow body of the ovary.

It appears needless to make any farther citation in this place.

I shall here offer the remark, that if the concave superficies of the ovisac or inner concentric, is really charged with the office of producing or excreting the vitellary matter of the ovulum, which must be admitted, even if we allow to that body the metabolic or plastic cell-force, (for it must, at least, be the producer of the cytoblastem of the cell,) there is no very great difficulty in admitting that the convex or exterior superficies of the membrane may exercise the same functions as a dominant of the elective affinities, which must be supposed of every vital excrete.

And such a supposition finds abundant support in the analogy of the organs; as in the periostial and medullary membranes of bones, for example; which, under certain circumstances, are known to alternate their functional force; the medullary membrane coming to be a depositer of phosphate of lime, instead of a remover; and the periosteum a remover, instead of being a depositer of phosphate, which is its normal office. This mutation of powers, as to the membranes of bone, has so clearly been described by M. Flourens, in his admirable paper on the production of bone and teeth, in the Annales du Museum, that it needs no comment.

But I am far from claiming this illustration for my view of the case; strong as I might deem it to be. It suffices for me to know, that vitellary matter is germinal matter, germinal cytoblastem; and that the business of an ovary is to produce it, which nothing else in nature can do.

As to the microscopic results at which I have arrived, I have nothing more to do than present them to the micrographers; and I should feel most happy if these remarks, meeting the eyes of Dr. Bischoff, or my kind friend, Dr. Pouchet, those gentlemen should deem them worthy of their attention, and confirmation or refutation. If they prove to be unfounded, I wish them to be confuted by better observers than I am.

As to some other points of resemblance, I have now to observe, that boiled corpus luteum becomes hardened, like yelk boiled hard. It is, in like manner, friable and granular, leaving a yellow stain on paper, like the stain from boiled yelk.

Dr. Thomas Schwann found it evidently coagulated, granular, and friable, upon being boiled.

In order to ascertain its odour, I threw a portion of corpus luteum on a live coal;—it gave out a strong odour of roasted eggs.

Are the granules and corpuscles of the corpus luteum cytoblasts and cells?

I have not been able so clearly to make out their nuclei, as to speak positively—I suppose them to be so. But Schwann, himself, who in one place seems to regard the nucleus as a *sine qua non* in cell-life, says, at page 204, of that most admirable and extraordinary volume, the Microscopische Untersuchungen:

Die kernloser zellen, oder richtiger ausgedruckt, die zellen, in denen bisjetzt noch keine kerne beobachtet werden sind, kommen nur bei niederen pflanzen vor, und sind auch bei Thieren selten. And he cites, as examples of the non-nucleated cell, the young cells within the old cells of the chorda dorsalis, the cells of the yelk of the bird's egg, &c., &c.

Be the non-nucleated vesicle a cell or not, it is very certain that the milk corpuscle, and, probably, the chyle corpuscle, is of that nature,—and no one can contemplate the amazing reproductive power of a cell or spore of the saccharomyces cerevisiæ, without admitting for it all the properties of the cell-force. It is to the last degree reproductive, as are also many of the filiform fungi, the muscardine, &c.

The question, at last, is whether I have made a discovery interesting to the physiologist, the practitioner, and the jurisconsult.

If I am right in my opinions, it must be interesting.

As a *resumé*, I say that my views are based upon the facts that,—

1. Equal masses of yelk and corpus luteum are equally yellow.

2. They alike fill the tube, before the focus is got, with a brilliant, yellow light.

3. They alike consist of a pellucid fluid, in which float granules, corpuscles containing yellow fluid, oil-globules, and punctiform bodies.

4. These bodies, placed on the same platine, and diligently compared together, exhibit the same forms, size, tint, and refractive power.

5. Yelk, boiled hard, is granular and friable; it is coagulated by heat.

6. Corpus Luteum, boiled, becomes hard, granular, and friable—it is coagulated by heat.

7. Both substances, raw or boiled, stain paper alike of a yellow colour. This experiment was repeated after Bernhardt, who says, Cujus pigmentum aurantiacum, (cor. lut.,) admotis digitis adhærescebat.—P. 39.

8. There is this difference:—The crushed mass of corpus luteum contains patches of laminar cellular tela, detritus, and blood discs, forced out by the compressorium; which cannot occur in the yelk, as it is contained in a vitellary membrane, in which its corpuscles are free; whereas, in the corpus luteum, they are confined by the delicate cellular substance betwixt the concentric laminæ of the Graafian follicle.

9. They refract alike.

10. Projected on a live coal, they alike give out the odour of roasted eggs.

While I, of course, derive this view from perception of my own senses only, I ought perhaps to take leave of it here, committing it to more capable observers, in order to know whether they perceive it as I do; such as Dr. Schwann, whose great and most esteemed politeness to me, last year, at Louvain, makes me hope he will examine it; as also, Dr. Pouchet, who has done so much, in his Théorie Positive de la Fécondation des Mammiféres, to clear the track of the physiologist and the physician.

But, while I suppose that farther observations may probably confirm my views, I see no objection why I may not now offer some remarks, in the way of a rationale, upon the point in question, in this paper, the more particularly, as I hitherto rely only upon my own observations.

I therefore state, that all living beings are results of the operation of a reproductive or generative force.

This is true both as to plants and animals; with the *possible* exception of certain fissiparous and gemmiparous creatures, as well as of certain sporiferous fungi, and some creatures of a higher scale, as the nais proboscidea, &c. I say of these, that they constitute a *possible* exception to the law of reproduction by germs. I do not say they are exceptions.

This reproductive force has the same relation to the conservation of the vegetable and animal genera, as the force of attraction has to the conservation of the brute masses of matter of the universe.

For it is obvious, that, but for this force, all the genera would die out in a single generation, and yet it is apparent that nothing is more permanent than the genera, which extend from age to age, touching the beginning, the whole course, and the end of time.

All the existing genera are the same to-day as at the commencement of the present cosmic career, and are destined to be so until the next great cataclysm of the globe. M. Flourens, in his work on generation, makes use of the *mot*, the saying, *un être collectif*, a collective being—in speaking of the immutable permanence of a genus. This fine saying leads the mind at once to a view of the importance of the law of genesis by which so great an end is attained.

It would, perhaps, be superfluous to say that, but for the exercise of this force, all *morals* would be nullified, and blotted out of the great scheme of Providence; for, should the genera fail or die out, the earth would become a desert; no flowers to bloom, no corn, nor wine, nor oil—no insect, to sport in the sun-beam—no song of birds—no lowing of cattle—no voice of man to acknowledge, and praise, and give thanks to the Giver of every good and perfect gift. Thus the whole scheme of morals would cease and be terminated, leaving no witness here to the power of God, beyond the senseless play of the elective and gravitating attractions.

Is it not clear, then, that the laws of this great conservative force must be most important laws? Can such great forces have little or no concern with the regulation and co-ordination of the other life forces? I repeat, that for life they have the same importance as appertains to the laws of attraction for the physical bodies of the globe.

This force is the true development force, not only for the germ, but for the embryo, the fœtus, the child, the youth, and the man. He who shall know it truly, shall know the laws of life.

It is not only a generative, but a generic force. It determines the genera in an endless succession of ages. No horrid passion, no wild lust, no insane desire can contravene the irreversible law of the distinction of the species and genera—"each after its own kind,"—which, but for its provisions, would rush into chaotic confusion and mixture —whereas they are, in truth, trenchantly divided, and set apart, and maintained for ever, pure and unmixed.

This force—this amazing force, is concentrated and summed up in a special animal or vegetable tissue. Nothing in animals, save a vitelliferous tissue can yield or give out this force. It is the endowment of an ovarian stroma, as it is called, by Von Baer. It is the peculiar life-property of that concrete, and of nothing else.

The stroma (Lager,) of ovaries, is a tissue developed and sustained by the combined agency of a spermatic or ovarian artery, and a spermatic nerve.

The spermatic nerve possesses an intimate plexus and ganglionic relation to the spinal, the sympathetic, and the splanchnic systems of innervation—so that it is related, in fact, to all the organisms.

Under the dominant indicative influence of the spermatic nerve, the ovaric artery, by its branches and termini, deposites the materials of the concrete of the stroma, with all its parts and mechanism.

The general relations of the ovary with the whole of the innervations, while it enables it largely to influence them all, renders it liable to disturbance by their derangements. Its great influence is exhibited in pronouncing the single word sex, for the ovary is the

sex of the woman, or the female. But if the ovary be her sex, then the whole physical, moral, and intellectual character of the female are derived from it, as their source and dominant—they are conformed to its wants, its powers, its offices, and modified often by its conditions.

The materials of development for all the organs are derived from the blood, which may, without violent misapplication of the metaphor, be said to exist in a multilocular cyst, of which the cellulæ are the different sanguiferous tubes and cavities of the vascular system. It is every where the same, and presents in each of the organs the same liquor sanguinis, and discs—so that although all development is at the expense of the blood, yet there is another, and esoteric force, to compel the elective attractions by which every living concrete is produced.

The physiologist knows that this esoteric force is nerve force—and he will not deny that, for the development of both a general and special anatomic structure, it must possess what I desire to characterize as a generic force, else all development would be in spherical forms, and of the same constituent elements.

No power can so modify the generic force of the nerves and blood vessels of the cephalic extremity of the inchoate embryo as to protrude from it a pelvis or a foot. Nor could a leg be possibly developed in the place of a prehensile limb. Even in the quadrimana the law holds good.

A liver whose development depends on its nutritious artery and its nerves, could by no means be formed at the caudal or cephalic pole of a mammal. It must always have its centrical position. No examples will be found of a lung placed below the diaphragm. Hence, I say, the law of generic development is a law applicable not to the creature only as a whole, but to each of its several constituent parts. The whole business of zoological classification depends upon this order.

This law not only operates during the embryonal, the fœtal and the puberic development, but is in force throughout the whole duration of life, perpetually repairing the organs, and maintaining their *generic* force, against the waste and detritus of life, until the cessation of life.

The membrana germinativa of the ovum, which is probably R. Wagner's macula, (Keim fleck,) is an elliptical or circular disc. No power could determine the production of the pelvic at the cephalic, or the cephalic at the pelvic segment; nor a leg from the thoracic, or of an arm from the iliac region of the disc. Hence it is true to say, that such disc is endowed at different parts of it with a generic force, operative only in that one sole direction. I say generic, since the idea is applicable to all animals whatever.

My motive for making the foregoing remarks was, that they might serve as an induction or basis, on the generic force of *ovaries*.

An ovary is developed by an ovaric trunk and its branches, drawing the vital current from the aorta or the emulgent, and attended by the spermatic nerve, which I regard as a reproductive nerve, and generic in its powers.

I say a reproductive nerve, since its innervation is devoted to the evolution of germs. No other nerve has such a mission: I say germs—or germ cytoblastem.

If Huschke's pretty idea should prove to be well founded, I see no escape from the attribution of this reproductive quality to the spermatic nerve. Huschke supposes that each Graafian follicle is a cast-off acinus of the stroma, carrying away in its fall an endowment of vital force rendered complete by fœcundation.

But, without discussing the question of the aciniferous nature of the stroma, the same attribution of the nerve power is true, even under the hypothesis of an independent cell-life—for a reproductive cell could not exist but for the vitellary cytoblastem provided by the stroma, which is a vitelliferous tissue, and only that. Nothing else is so. The nature of the cytoblastem must determine the differences of cells. The cell of an oak germ is not the cell of a cabbage germ.

But the whole office of an ovary is to produce or prepare germs—it is germiferous; and it is so by its power to form vitellary matter. No other combination or arrangement of animal materials can produce yelk or vitellus.

The complete germ is contained within a vitellary membrane—which is the boundary of the yelk. In the mammals this yelk is microscopic. In the ostrich and the cassowary it is a very large ball, as it is in some of the larger ophidians, as in the coluber boæformis, &c.

The matured germ contained within a yelk is spontaneously and periodically extruded from the ovary, in order that it may be fairly exposed to the contact of the male fœcundative element—which should be deemed impossible while it is buried within the recesses of the ovarium, covered by the double tunic of the follicle, and beneath both the fibrous and peritoneal indusium of the organ.

To effect this extrusion, this spontaneous oviposit, the inner concentric spherule of the follicle is compressed, by the deposition on its external convex surface, of yelk grains, corpuscles, oil-globules, punctiform bodies, and pellucid fluid—which gives to the concave surface of the cell an appearance of corrugations or convolutions like those of the brain, and which, as they daily increase by the continued deposit of yelk matter on the exterior, constantly reduces the size of the interior dimensions of the follicle, urging its contents towards the least resisting point of the surface of the ovary, until, at length the *porule* being opened, the ovulum escapes into the fimbria, or falls with the peritoneal sac, according to circumstances.

After the escape of the ovulum, the yelk-producing force is not exhausted immediately, in all cases; hence the growth of the corpus luteum continues.

It is a periodical exacerbation that matures and bursts the Graafian cell. When the process of completing a germ and expelling it has been finished, the exacerbation ceases sooner or later, and a new periodical exacerbation of this strange life force—or germ-producing force—is devoted to the maturation and spontaneous oviposit of another ovulum, and so on in succession, during the menstruating life of the woman; at every successive pairing season of birds; and at the annual rutting time of the more considerable mammals, and with all the migratory fishes.

It surprises me to see that many able and distinguished writers still cling to the antiquated notions as to the ovaric fœcundation, which M. Pouchet has shown to be an

impossibility. It appears to me that my view of the vitellary composition of the corpus luteum, and the mechanical result of its accumulation in effecting the oviposit ought to be received as satisfactory rationale of the germ-depositing function. The fœcundation of germs is a mystery which I deem beyond human cognition—and likely ever to remain so. The inquiry into the corpus luteum is far more feasible and practicable. No woman can menstruate but coincidently with, and in consequence of, the oviposit. Every oviposit is followed by a corpus luteum, which is larger or smaller, according to circumstances. Many women have scarce discernible ones after conception—others have very large ones. The true and false corpora lutea differ only in magnitude—not in their essential nature.

ARTICLE VII.

Investigations which led to the detection of the coincidence between the computed place of the Planet Leverrier, and the observed place of a Star recorded by Lalande, in May, 1795. By Sears C. Walker. Read February 19th, 1847.

Washington, D. C., February 13th, 1847.

To Dr. Robert M. Patterson:

My Dear Sir,—I hasten to comply with the invitation in your letter of yesterday to lay before the American Philosophical Society the steps that led to the detection of the very remarkable coincidence between the computed place of the planet Leverrier and the observed place of a star of the 7.8 magnitude, which passed the meridian of Paris at 14*h*. 11*m*. 23*s*.5 of Lalande's clock time, May 10th, 1795.

Soon after the arrival of the news of the *physical* discovery of Leverrier, a suggestion, by Mr. E. C. Herrick, of its possible identity with the Wartman planet of 1831, induced me to commence the search for the approximate elements of the two. I soon came to the conclusion that Leverrier could not have been in Wartman's region in 1831, and that no satisfactory orbit could be found for Wartman's planet, from the imperfect tracing of its path in the Contes Rendus for 1836.

In this first inquiry concerning the motions of Leverrier, I learned the near approach of its orbit to the circular form. The same analogies of the solar system that furnished Leverrier and Adams the clue to their *analytical* discovery of the planet, were to be the guides in the first attempt to sketch its orbit.

It was naturally to be presumed that the inclination and eccentricity of this primary planet were small, and that with a radius vector nearly twice that of Herschel, the sun's power to impress daily variations of the radius vector, and orbital motion must be comparatively small, and that in a first approximation these daily variations, as well as their first and second differences, might be neglected.

Accordingly, I commenced with the simple hypothesis of *constancy* of the *radius vector*, from September 26th, to November 21st, a period of fifty-eight days, leaving the character of the orbit, whether nearly circular or much flattened, to be the result of the investigation.

Nine European observations combined, furnished me one place of Leverrier, September 26, 1846. Three Washington observations, October 24th, and three more, November 21st, completed the three observed places. I commenced with the trial of radii vectores 33 and 34, which include Leverrier's and Adams's hypothetical values. I found that 33 was too great, and extended the scale downwards to 32, 31, 30, and 29.

I subjoin the table of computed daily sidereal orbital motions for the three intervals, of thirty days from September 26; fifty-eight days from September 26; and twenty-eight days from October 24, for this scale of assumed constant radii vectores. They are the results of an *approximate* computation only. r is the radius vector, n' is the daily sidereal orbital motion for the first thirty days, n for the whole term of fifty-eight days, and $n_{,}$ for the last twenty-eight days. μ is the mean daily sidereal motion for $r = a =$ the semi-axis major.

r	n'	n	$n_{,}$	μ
34	12″.8	16″.7	19″.7	17″.90
33	14 .6	17 .7	20 .3	18. 71
32	16 .6	18 .8	20 .8	19. 60
31	19 .4	20 .1	21 .2	20. 56
30	21 .7	21 .6	21 .6	21. 58
29	24 .1	23 .4	22 .0	22. 67

The same analogies that led to the assumption of the *constancy* of the radius vector for fifty-eight days, also lead to the conclusion that n must be nearly constant. Accordingly, the true radius vector, to be interpolated from this table, was that in which $[(n - n')^2 + (n - n_{,})^2]$ should be a minimum.

A slight inspection of the table shows that this value of r is very nearly 30.0, and that since for this value $n' = \mu$, $n = \mu$, and $n_{,} = \mu$, very nearly, therefore $a = r$ very nearly. In other words, the orbit approaches very nearly to the circular form, and that which was at first inferred from the analogies of the solar system (viz., the smallness of the eccentricity,) is now established as a deduction from actual observation.*

I was now prepared to commence a rigorous computation of the *circular* elements, on the hypothesis of a uniform radius vector, $r = a$. For this computation two observed places are sufficient. I chose the above place of the 26th of September, and a place deduced from my own observations with the Washington Equatorial, December 26th. On this night I compared Leverrier in right ascension by transits, thirty-three times, with each of the two Enckian stars which have been used for comparison with Leverrier from its discovery by Galle, to the middle of January last. I also compared it eleven times in declination with the same stars, with the filar micrometer.

A test of the precision of a night's work with the equatorial is furnished by the fact that the observed relative position of the two fixed stars should be constant on all the nights. In this way I found the probable error of one night's work to be about 0″.6 of space in Diff. R. A., and 0″.5 in Diff. Dec. I mention this to show the precision of the measured path when many nights' works are combined, and the comparisons are throughout made with the same stars. After correcting the observed places for parallax, and

* The possible accidental case of $r = a$ in a very eccentric ellipse, was rejected from its improbability.

the dates for aberration time, (which amounts to about four hours,) I computed the (I.) elements in the table below. The data for the computation were obtained as follows. The planet's mean place as a fixed star for January 1st, 1847, was derived from the observations. The correction for planetary parallax was applied. The R. A. and Dec. were then reduced to their equivalent geocentric latitude and longitude (α and δ,) referred to the mean equinox of January 1st, 1847, with the mean obliquity. The places are,

*Greenwich mean time,	θ, θ'	=	$1846^y\ 268^d.33333$;	$1846^y\ 359^d.5$
Aberration time,	$\triangle\theta, \triangle\theta'$	=	$-0^d.16755$;	$-0\ .17563$
Reduced time,	t, t'	=	" $268^d.165783$;	" $359^d.32437$
Planet's Geo. Lon.,	α, α'	=	$325°49'\ 1''.48$;	$326°\ 4'\ 2''.64$
Planet's Geo. Lat.,	δ, δ'	=	$-0°31'57''.81$;	$-0°31'26''.37$
Concluded hel. Lon.,	λ, λ'	=	$326°59'\ 5''.40$;	$327°31'59''.00$
Concluded hel. Lat.,	β, β'	=	$-0°31'\ 7''.089$;	$-0°32'\ 4''.791$
	$\lambda'-\lambda$, $\beta'-\beta$	=	$+0°32'53''.60$;	$+0°\ 0'57''.702$
Orbital Longitudes,	v, v'	=	$326°59'32''.73$;	$327°32'27''.09$
True motion, in whole term, $v-v'$		=	$0°32'54''.36$;	
$\frac{v'-v}{t'-t}$ =	n,	=	$21''.658575$;	
For $r = a = 29.93995$,	μ	=	$21''.658575$;	

The smallness of the values of $\lambda'-\lambda$, and $\beta'-\beta$, on which the concluded position of the plane of the whole orbit depends, would have deprived this result of all its value, if the errors of observation had not also been extremely small, so as to bear a corresponding proportion to the measured path. There is, however, one advantage accompanying this smallness of $v'-v$, viz., that the errors arising from the neglected terms, (the daily variations of r and n,) are more nearly insensible.

With the elements (I.) I computed with every possible precision an ephemeris of Leverrier from August 1st, 1846, to February 1st, 1847, and then compared with it all the standard observations yet received, after applying all the small corrections, and treating them in the same manner as the places of September 26th and December 26th, above.

The available observations comprehend one hundred and sixteen nights' works in all. They may be thus classified.

MERIDIAN OBSERVATIONS.

No. of nights observed.	Observatory.	Instrument.	Observer.
5	Göttingen,	Meridian Circle,	Gauss.
13	Altona,	"	Petersen.
17	Hamburg,	"	Rumker.
4	Dorpat,	"	Madler.
4	Konigsberg,	"	Wichtman.
3	Geneva,	"	Plantamour.
2	Turin,	"	Plana.
8	Cambridge, E.,	"	Challis.
5	Washington,	Transit Inst.,	Almy.
1	"	"	Keith.
6	"	Mural Circle,	Coffin.
1	"	"	Page.
3	"	Ertel. Merid. Circle,	Maynard.
5	"	"	Hubbard.

* The earth's *true* place is taken out from the time θ, and θ'. The earth's latitude was taken into account.

DIFFERENTIAL MEASURES.

No of nights observed.	Observatory.	Instrument.	Observer.	Star of Comparison.
10	Berlin,	Great Equatorial,	Encke and Galle,	α of Encke.
6	Cambridge, E.,	" "	Challis,	7648 B. A. C.
7	Washington,	" "	Maury,	7648 α a
11	"	" "	Walker,	7648 α a
4	"	" "	Hubbard,	7648 α a

The place of the star seventh magnitude 7648 B. A. C. rests upon the following authorities. Piazzi, Mayer, Taylor, Challis, six observations; Plantamour, four observations; Plana, one observation; Washington observatory, twenty-five observations. The above are direct observations of 7648 B. A. C. There are also ten Berlin, and three Washington equatorial comparisons of 7648 B. A. C. with Leverrier directly or through $*$ a, on nights when Leverrier was observed on the meridian, and its place was reduced to a common date.

The other star, Encke's $*$ a, ninth magnitude, has for its place the following authorities, Bessel's Zones, Encke and Galle, two nights' comparisons with 7648 B. A. C., Encke, five nights' comparisons with Leverrier referred on these nights to fifteen meridian observations; Maury, six; Walker, ten nights' comparisons with 7648 B. A. C.

I have adopted the mean place of the two stars from all these authorities for January 1st, 1847, as follows:

7648 B. A. C.	7th mag.,	R. A. 1847,	327°32′16″.79	December, 1847,	—13°23′39″.17
$*$ a of Encke,	9th mag.,	"	327°57′42″.81	"	—13°25′57″.22

I do not think that the error of either of these star's places much exceeds one second of space.

By means of my ephemeris I was able to compute the value of c, or the mean of the second differences of the planet's daily places in R. A. and Dec. with a certainty of an error not exceeding 0″.02. The group of observations of any seven consecutive nights were reduced to the corresponding value for the fourth night, by the following formula, in which the differences c of the daily motions, and not of the motions themselves, are employed.

$$\text{I. Normal place (4th night,) } \alpha = \frac{1}{\Sigma\, h\, h}\Big[\, h\, h \left(\alpha_0 \qquad\qquad\qquad\qquad\right)$$
$$h'\, h' \left(\tfrac{1}{2}\alpha_{-1} + \tfrac{1}{2}\alpha_{+1} \quad - \tfrac{1}{2}\, c \quad\right)$$
$$h''\, h'' \left(\tfrac{1}{2}\alpha_{-2} + \tfrac{1}{2}\alpha_{+2} \quad - \frac{2\times 2}{2}\, c\right)$$
$$h'''\, h''' \left(\tfrac{1}{2}\alpha_{-3} + \tfrac{1}{2}\alpha_{+3} \quad - \frac{3\times 3}{2}\, c\right)\Big]$$

Where

n = the number of nights' works combined for single night.

$$h = \sqrt{n}$$
$$h' = \sqrt{\left(4, \frac{n_{-1} \times n_{+1}}{n_{-1} + n_{+1}}\right)}$$
$$h'' = \sqrt{\left(4, \frac{n_{-2} \times n_{+2}}{n_{-2} + n_{+2}}\right)}$$
$$h''' = \sqrt{\left(4, \frac{n_{-3} \times n_{+3}}{n_{-3} + n_{+3}}\right)}$$

In this manner I obtained from the above list of observations of Leverrier sixteen normal places, which I subjoin, together with the corrections of the ephemeris. In this list α and δ are the mean places of Leverrier as a fixed star in latitudes and longitudes referred to the mean equinox and mean obliquity of January 1st, 1847, corrected for planetary parallax, but not corrected for planetary aberration.

NORMAL PLACES OF LEVERRIER.

No. of Place.	Mean Time, Greenwich.	Obs. Geo. Lon. α	No. of Obs.	Obs. Geo. Lat. δ		Obs. Eph. $\Delta\alpha$	Obs. Eph. $\Delta\delta$
1	1846 215^d.56696	328° 9′49″.34	(1)	— 0°31′36″.24	(1)	— 16″.75	— 0″.63
2	223 54405	327 57 9 .04	(1)	44 .09	(1)	— 7 .27	— 1 .03
3	270 5	325 46 25 .82	(16)	57 .99	(16)	— 1 .02	+ 0 .84
4	276 5	39 54 .23	(13)	56 .14	(13)	+ 0 .27	+ 1 .51
5	282 5	34 16 .11	(13)	56 .09	(13)	+ 1 .12	+ 0 .03
6	290 5	28 21 .99	(12)	53 .16	(12)	+ 3 .13	+ 0 .80
7	298 5	24 25 .25	(18)	51 .13	(19)	+ 4 .19	+ 0 .56
8	306 5	22 32 .46	(6)	47 .61	(6)	+ 3 .02	+ 0 .23
9	313 5	22 40 .00	(4)	45 .15	(3)	+ 2 .40	— 0 .68
10	319 5	24 6 .41	(4)	41 .51	(6)	+ 1 .95	+ 0 .51
11	325 5	26 50 .59?	(4)	37 .30?	(4)	+ 3 .77?	+ 2 .21? *rej.*
12	334 5	23 9 .44	(7)	33 .92	(6)	+ 2 .46	— 1 .13
13	345 5	44 26 .93	(4)	30 .79	(4)	+ 0 .96	— 0 .03
14	353 5	54 58 .01	(2)	27 .10	(2)	— 0 .72	+ 1 .51
15	359 5	326 4 2 .54	(3)	26 .04	(3)	— 0 .23	+ 0 .77
16	372 5	326 26 39 .11	(3)	23 .60	(3)	— 4 .40	+ 1 .28

A slight examination of the corrections of the ephemeris from Elements (I.) deviates slightly though sensibly from the circular form. Accordingly, the next step in the investigation was to remove the restriction $r = a$, $n = \mu$, and merely suppose the radius vector constant during the observed interval, and leaving n to take such a value as the observations should require.

For this purpose let $x = 50 \times \Delta r$

$y = 10 \times \Delta \nu$

$z = \Delta \lambda_{300}$ = correction of hel. lon. by Eph., October 29th, 1846.

ν = daily motion in hel. lon.

From the sixteen normal places nine equations of condition were formed, with equal weights. No. 11 was rejected. Equation 1 is the third of the mean of Nos. 1 and 2. Equations 2, 3, 4, 5 and 6, are Nos. 3, 4, 5, 6 and 7, respectively. Equation 7 is the mean of Nos. 8, 9 and 10; Equation 8 of Nos. 12 and 13; Equation 9 of Nos. 14, 15 and 16.

After reducing the correction of the geocentric to those of heliocentric longitudes and latitudes, and computing the coefficients of x and y (that of z is always 1,) the nine conditional equations from the latitudes were,

								Outstanding Error.
1	;	$0 = -0.303 \times x$	$- 2.700 \times y$	$+ 0.333 \times z$	$+ 3''.88$	;	$- 0''.08$
2	;	$= + 3.016$	$- 3.000$	$+ 1.$	$+ 1\ .00$	;	$+ 0\ .49$
3	;	$= + 3.363$	$- 2.400$	$+ 1.$	$- 0\ .27$	;	$+ 0\ .19$
4	;	$= + 3.685$	$- 1.800$	$+ 1.$	$- 1\ .10$	;	$+ 0\ .22$
5	;	$= + 4.038$	$- 1.000$	$+ 1.$	$- 3\ .07$	;	$- 1\ .03$
6	;	$= + 4.268$	$- 0.200$	$+ 1.$	$- 4\ .12$	;	$- 1\ .31$
7	;	$= + 4.594$	$+ 1.267$	$+ 1.$	$- 2\ .44$	;	$+ 1\ .03$
8	;	$= + 4.248$	$+ 3.950$	$+ 1.$	$- 1\ .73$	;	$- 0\ .13$
9	;	$= + 3.332$	$+ 6.133$	$+ 1.$	$+ 1\ .81$	;	$- 0\ .16$

Whence the three normal equations,

$$\begin{aligned} 0 &= 118.879 \times x + 7.477 \times y + 30.443 \times z - 45''.629 \\ 0 &= 7.477 + 85.149 + 0.250 + 1\ .687 \\ 0 &= 30.443 + 0.250 + 8.111 - 8\ .627 \end{aligned}$$

And

II.
$$\begin{cases} x = + 3\ .255712\ , & r = 29.939950 + \frac{x}{50} = 30\ .005064 \\ y = - 0''.272963\ , & n = \frac{v'-v}{t'-t} = 21''.65789 \\ z = - 11\ .1475\ , & v \text{ Sept. 28th, 1846} = 326°59'34''.74 \end{cases}$$

The values of n and v are the result of a new computation with the new radius vector 30.005064. The sum of the squares of the errors in heliocentric longitude of Elements (I.) for the nine equations is $55''.96$. The sum of the similar quantities for Elements (II.) is $4''.21$, which is the sum of squares of nine errors, each of which is composed of the united errors of theory and observation.

In my paper on meteors in the Memoirs of the American Philosophical Society, New Series, Vol. VIII., I have given the well-known equations,

III.
$$\frac{1}{a} = \frac{2}{r} - g^2 = \frac{2}{r} - \left(\frac{rn}{\text{Gauss's } \varkappa}\right)^2$$

IV.
$$er \cos v = a \cos^2 \phi - r = a(1-e^2) - r$$

In which g is the true orbital velocity in units of the earth's mean orbital velocity. Equation (III.) by means of r and n in Elements (II.) gives $a = 30.200585$. Equation IV. gives the value of v for any assumed value of the eccentricity. It is of the second degree and gives the value of either in the first or fourth quadrant. It is not possible from the process above pursued, to decide between the two quadrants of v. By hypothesis the daily variation of r was neglected. Hence it remains uncertain whether the r of Elements (II.) belongs to the first or fourth quadrant.

It is possible that the insertion in the conditional equations of two more terms for the daily variations of r and n might decide this point. Before attempting this inquiry I resolved to examine the ancient catalogues for the purpose of detecting Leverrier as a missing star.

Among the catalogues to be resorted to were Bradley's, Lacaille's, Mayer's, Lalande's, Piazzi's, Bessel's, Brisbane's and Taylor's. The first three of these catalogues do not usually include stars of the 7.8th magnitude. In the recent publication of Piazzi's original observations by the Vienna Observatory, extending from 1792 to 1798, I do not find among the stars observed by Piazzi and not afterwards identified, any which came

within reasonable limits of Leverrier's computed place on the nights of observation. From 1821 to 1832, the term of Bessel's zone observations, Leverrier was near the southern point of the ecliptic, and consequently below Bessel's limit. Brisbane's catalogue is not by me at present, and Taylor's observations at Madras are usually confined to the reviewing of stars in previous catalogues. There remained only Lalande's catalogue which offered hopes of success at present. A sketch of the Leverrier regions for several periods from 1790 to 1800, soon showed that there were but two nights in which I could expect to find observations of Leverrier in the Histoire Celeste, viz., those of the 8th and 10th of May, 1795. The corrections of the clock and quadrant for these two nights are nearly the same. Accordingly, I made an approximate computation of Leverrier's place on the latter night from my Elements (II.,) using the present radius vector and present orbital motion, viz., 21″.6 ± 0″.3. This limit appeared to me sufficiently extensive to include the probable place. After reducing the computed R. A. and Dec. from the mean equinox of January 1st, 1847, to the apparent place for May 10th, 1795, and then applying the reductions to Lalande's clock time and recorded zenith distance, I found by this approximate computation the *locus* of the Leverrier region, May 10th, 1795, thus,

	Clock time of transit.	Quadrant reading.	
Leverrier if in H. C. ✳ 7.8 mag.;	13*h*. 59*m*. 2*s*.;	59° 6′ 7″;	supposed western limit.
✳ 7.8 ;	14 5 17 ;	59 37 21 ;	probable place.
✳ 7.8 ;	14 11 32 ;	60 8 35 ;	supposed eastern limit.

All the stars observed in this region on the 8th of May, 1795, were below the 7.8 magnitude, and were found in Bessel's Zones.

The only star in this region on the 10th reads thus:

	Clock time of transit.	Quadrant reading.
Histoire Celeste. ✳ 7.8 mag.;	14*h*. 11*m*. 23*s*. 5 ;	60° 7′ 19″

I was at once struck with the coincidence in quadrant reading of this star with that part of the *locus* of Leverrier which has 14*h*. 11*m*. 23*s*.5 for its clock time, and which has for its quadrant reading 60° 7′ 50″. I examined Bessel's 242d Zone, comprising the same region. The Lalande star was not there.

This computation and comparison with the H. C. was made on the evening of the 2d of February, a cloudy night. I extended the limits to those which would result from ± 0″.6 of difference of average orbital motion since 1795. Still there was no other star in the H. C. which could have been supposed to be Leverrier. The only other star in this region of double extent, not found in Bessel's Zones was entered by Lalande as of the ninth or tenth magnitude.

I immediately drew up a statement of my conviction that the star 7.8 mag., 14*h*.11*m*.23*s*.5 of the H. C. of May 10th, 1795, was Leverrier, and that on search for it the next clear night it would therefore be missing. My confidence was such that I furnished this statement to Lieut. Maury, and submitted a copy made for my private use to my friends Prof. Hubbard, Prof. Coffin, Lieut. Gillis, Prof. Bache, and Prof. Henry. It is proper to add, that both Prof. Hubbard and Prof. Coffin, who were familiar with all the steps of the inquiry, expressed their strong belief that the star would be missing on an appeal to the

heavens. I furnished Prof. Hubbard with the list of guide-stars from Hussey's XIVth Hour of the Akademischen Sternkarten, as follows:

Mag. 9 ,	R. A. 1800, 14*h*. 8*m*. 1*s*.,	Dec. 1800,	— 11°39′.2,	Authority B_1
9 ,	8 3 ,		— 11 27 .5	B_1
8 ,	8 5 ,		— 11 8 .0	B_2
8 ,	10 0 ,		— 11 26 .5	L_2 B_1
9 ,	10 27 ,		— 10 55 .1	B_1
8 ,	10 33 ,		— 10 28 .4	L_1 B_1
9 ,	11 27 ,		— 10 53 .3	L_1
8 ,	12 0 ,		— 11 8 .3	L_1 B_1
7.8,	12 1 ,		— 11 21 .0	L_1 { Expected to be missing as being Leverrier.
6 ,	12 41 ,		— 10 47 .6	B_2 P
9 ,	13 20 ,		— 11 25 .8	B_1
7 ,	13 57 ,		— 10 45 .2	B_2 P
9 ,	15 53 ,		— 10 42 .9	B_1
8.9,	20 32 ,		— 10 58 .4	L_1 B

The first clear night after detecting this coincidence was the fourth of February. Prof. Hubbard examined the region with the Equatorial, and reported to Lieut. Maury the next morning, February 5th, that he had found all the guide-stars in this list; but that the star that was designated as *expected to be missing*, was indeed *missing*.

Prof. Hubbard reviewed the region several times. The star which should have preceded the missing star by 1° was in place. It was brought to the middle transit wire and to the bottom of the field. The Lalande star should have been in the upper portion of the field. It was not there. Nor was there in the vicinity any star that could be reasonably supposed to have been erroneously recorded as in the place of the missing star. I may add, that this region has since been examined by Lieut. Maury and Prof. Hubbard. The star is certainly *missing*.

On the hypothesis that this missing star was Leverrier, I have computed the (III.) Elements below. They show that on this supposition Leverrier is now approaching the perihelion, or, in other words, is in the fourth quadrant of true anomaly.

I submit the three sets of elements above referred to:

Elements of Leverrier, for mean time Greenwich referred to the mean Equinox of January 1st, 1847.		Circular Hypothesis. I.	Elliptic Hypothesis. II.	Elliptic Elements if identical with the missing star of Lalande's H. C. III.
Longitude of the perihelion	π	Unknown	Unknown	0° 12′ 25″.51
Longitude of the ascending node	Ω	129° 48′ 23″.16	129° 48′ 23″.16	131° 17′ 35″.80
Epoch of mean longitude, Jan. 1st, 1847	M	Unknown	Unknown	328° 7′ 56″.64
True longitude on the orbit, Sep. 28th, 1846	ω	326° 59′ 41″.50	326° 59′ 34″.74	326° 59′ 34″.74
Radius vector, Sep. 28th, 1846	r	29.93995	30.005064	30.02596
Daily sidereal orbital motion, Sep. 28th, 1846	n	21″.658575	21″.65789	21″.64553
Inclination	i	1° 45′ 19″.88	1° 45′ 19″.88	1° 54′ 53″.83
Eccentricity	e	0	Unknown	0.0088407
Mean distance	a	29.9395	30.200585	30.25042
Mean daily sidereal motion	μ	21″.658575	21″.37881	21″.32600
Period in tropical years	T	163^y.8259	165^y.9703	166^y.38134

The question of their identity will be decided in due course of time. If confirmed, this observation of Lalande will be exceedingly precious to the astronomer in discussing the question of the existence of other planets superior to Leverrier.

I have remarked, that the above estimate of the limits of the Leverrier region for May 10th, 1795, was based on only approximate computations. I expected to examine all the stars in this region with the Equatorial, and if any were missing that were seen by Lalande, then to investigate the question of their identity with Leverrier. The coincidence in place with the Lalande star which induced me to believe beforehand that on examining the heavens it would be missing, was quite unexpected. I have stated the particulars that led to this singular coincidence. Now that the star is known to be missing, I will proceed to examine the plausibility of the hypothesis of their identity.

The first objection to this hypothesis is, the shortness of the period compared with the *hypothetical* periods obtained by Adams and Leverrier (first published by the latter,) from the equations of condition derived from the residuary perturbations of Herschel. To this objection it may be answered, that both of those analytical discoverers of Leverrier assumed as the basis of their research a mean distance double that of Uranus, and then only diminished its value as the distortion of the other resulting elements compelled them to do so. Hence the extraordinary eccentricity in their first results, $\frac{16}{100}$ by Adams, and $\frac{11}{100}$ by Leverrier. Had they allowed free scope to the variations of the mean distances instead of forcing the other elements to conform to the preconceived value, I doubt not that a shorter period and more nearly circular orbit would have resulted. In proof of this remark I will quote from Mr. Adams's letter of September 2d, 1846, to the Astronomer Royal, (see pages 529 and 530 of the London and Edinburgh and Dublin Philosophical Journal, No. 197, for December, 1846.)

"*St. John's College, Cambridge, September 2d*, 1846.

"In the investigation, the results of which I communicated to you last October, the mean distance of the supposed disturbing planet is assumed to be twice that of Uranus. Some assumption is necessary in the first instance, and Bode's law renders it probable that the above distance is not very remote from the truth: but the investigation could scarcely be considered satisfactory while based on any thing arbitrary; and I therefore determined to repeat the calculation, making a different hypothesis as to the mean distance. The eccentricity also resulting from my former calculations was far too large to be probable; and I found that although the agreement between theory and observation continued very satisfactory down to 1840, the difference in subsequent years was becoming very sensible, and I hoped that these errors, as well as the eccentricity might be diminished by taking a different mean distance. Not to make too violent a change, I assumed this distance to be less than the former value by about one-thirtieth part of the whole. The result is very satisfactory, and appears to show that *by still farther diminishing the distance, the agreement between theory and the later observations may be rendered complete, and the eccentricity reduced at the same time to a very small quantity.* The mass and the elements of the orbit of the supposed planet, which result from the two hypotheses, are as follows:

	Hypothesis I. $\left(\frac{a}{a'} = 0.5\right)$	Hypothesis II. $\left(\frac{a}{a'} = 0.515\right)$
Mean longitude of the planet 1st October, 1846,	325°8′	323°2′
Longitude of the Perihelion	315°.57	292°.11
Eccentricity	0.16103	0.12062
Mass, (that of the sun being 1)	0.00016563	0.00015003

"The investigation has been conducted in the same manner in both cases, so that *the differences between the two sets of elements may be considered as wholly due to the variation of the fundamental hypothesis.*

"The errors given by the Greenwich observations of 1843, are very sensible, being, for the first hypothesis + 6″.48, and for the second, + 5″.50. By comparing these errors, it may be inferred that the agreement of theory and observation would be rendered very close by assuming $\frac{a}{a'} = 0.57$, and the corresponding mean longitude on the 1st of October would be about 315° 20′, which I am inclined to think is not far from the truth. *It is plain also that the eccentricity corresponding to this value of* $\frac{a}{a'}$ *would be very small.*"

This letter of Mr. Adams's is exceedingly valuable in the present inquiry. His most probable value of $\frac{a}{a'} = 0.57$ gives 33.6842 for the mean distance. The variation of the eccentricity, according to Adams's Elements I. and II. for a variation of about one-thirtieth of the primitive mean distance of 38.4, in $\frac{4141}{16103}$ths of the eccentricity when the primitive value is 0.16103. From this proportion between the variations of the mean distance and eccentricity, the value of $e_{,}$ of the latter may be derived from any assumed value $a_{,}$ of the former by the formula

$$\text{V.} \qquad e_{,} = 0.16103 \times \left[\frac{0.12062}{0.16103}\right]^{\left(\frac{\log \frac{a_{,}}{38.4}}{\log \frac{1}{1.03}}\right)}$$

With the mean distance $a_{,} = 30.200585$ of my Elements II., formula V. gives for the eccentricity $e_{,} = 0.01538825$. I am thus enabled to complete Elements II. without any assumption respecting the missing star of Lalande, with one deficiency only, and that is the want of knowledge of the fact whether the radius vector is now increasing or diminishing. The complete elements for the only two possible cases are,

Elements of Leverrier, in which the mean distance is derived from actual *observation*, and the *eccentricity* from the mean distance, by means of the ratio between them computed by Adams from the observed residual perturbation of Herschel, referred to the mean equinox of January 1st, 1847, and to mean noon, Greenwich.		CASE I. for radius vector now *increasing* ELEMENTS II.	CASE II. for do. *diminishing* ELEMENTS II.
Longitude of the perihelion,	π	261° 4′ 14″.20	32° 54′ 55″.28
" ascending node,	Ω	129° 48′ 23″.16	129° 48′ 23″.16
Inclination,	i	1° 45′ 19″.88	1° 45′ 19″.88
Mean distance,	a	30.200585	30.200585
Epoch of mean longitude, January 1st, 1847,	M	326° 33′ 59″.93	328° 32′ 51″.53
Eccentricity,	e	0.0153883	0.0153883
Period in tropical years,	T	165ʸ.9703	165ʸ.9703
Mean daily sidereal motion,	μ	21″.37881	21″.37881

With these elements which are the result of observed motions of Leverrier, and of observed residual perturbations of Herschel, I have computed Leverrier's place for May 10th, 1795, and reduced this place to the apparent equinox of that date, and to the actual condition of Lalande's clock and quadrant. The results are,

VI. May 10th, 1795, Leverrier as ✳ 7.8 mag. $14^h.\ 3^m.\ 14^s.81$; $59°\ 26'\ 47''$; Case I.
$14\ \ 14\ \ 10\ .48$; $60\ 23\ 20$; Case II.

It appears at once, on comparison with these computed places, that there is no star in the H. C. near the first which is not also in Bessel's Zones. The second place, for Case II., points at once to the remarkable star 7.8 mag., $14^h.\ 11^m.\ 23^s.5$; $60°\ 7'\ 19''$.

In order to determine the quadrant reading which the computed place would have from Elements II., Case II., if we vary the eccentricity so as to make the ephemeris give, for Lalande's clock time, $14^h.\ 11^m.\ 23^s.5$, I subjoin the locus of Leverrier, May 10th, 1795, for Case I. and Case II., and for eccentricities varying within the probable limit of that element. These limits I have taken as follows,

Minimum limit for $v = 0$, $r = 30.005064$, $e = 0.006474$
Maximum limit greater than that of Jupiter, Saturn, or Uranus, $e = 0.06$

ELEMENTS II.
Locus of Perihelion of Leverrier, and R. A. and Dec., May 10th, 1795, referred to mean equinox of 1800, for comparison with catalogues.

	e	π	R. A.	D.
Case I.	0.06	239° 45′ 23″.3	$13^h.\ 45^m.\ 50^s.$	— 9° 3′.1
"	0.05	241 34 53 .6	49 30	— 9 25 .7
"	0.04	244 2 17 .0	53 51	— 9 47 .8
"	0.03	247 46 18 .2	57 45	— 10 8 .1
"	0.02	254 47 30 .3	14 1 41	— 10 29 .1
"	*0.0153883	261 4 15 .2	3 52 .2	— 10 40 .40
"	0.01	276 54 7 .1	6 21 .9	— 11 9 .45
"	0.0064740	326 59 34 .7	9 18 .0	— 11 8 .75
Case II.	0.01	17 5 2 .4	12 9 .1	— 11 23 .46
"	*0.0153883	32 54 55 .3	14 47 .9	— 11 36 .97
"	0.02	39 11 39 .1	16 36	— 11 44 .5
"	0.03	46 12 51 .3	20 35	— 12 6 .3
"	0.04	49 56 52 .5	24 28	— 12 30 .8
"	0.05	52 24 15 .9	28 4	— 12 43 .2
"	0.06	54 13 46 .2	32 8	— 13 2 .6

The position of the missing star of Lalande for 1800 is.

	R. A. 1800.	Dec.
✳ 7.8 mag.	$14^h.\ 12^m.\ 0^s.0$	— 11° 20′ 58″
Leverrier by interpolation,	14 12 0 .9	— 11 22 56

Eccentricity by interpolation, 0.009875

The rigorous computation does not present so close a coincidence as my first approximation, February 2d. The place by interpolation is suited to the actual radius vector

* Value for Elements II. from formula V.

for the eccentricity 0.009875, whereas that of February 2d was made with the radius vector of September 28th, 1846, supposed unchanged.

The preceding table of the locus of π for the various values of e presents a striking confirmation of the other arguments in favour of the supposition of a small eccentricity. For the limits of e the table gives,

For,	$e = 0.06$,	$\pi =$ 239°.8		Case I.
			+ 37°.1	
	$e = 0.01$,	$\pi =$ 276 .9		Case I.
			+ 50 .1	
	$e = 0.006474$,	$\pi =$ 327 .0		Case I. or II.
			+ 50 .1	
	$e = 0.01$,	$\pi =$ 17 .1		Case II.
			+ 37 .1	
	$e = 0.06$,	$\pi =$ 54 .2		Case II.

If now, we suppose, in the original creation of the system, all points of the orbit as having equal probability of being perihelion points; and from the analogies of the system that 0.06, is the probable limit of the value of e, and that each degree of the orbit has a unit of probability (a priori) of being the perihelion point, we have for the number of such degrees within the above limits,

$$P = 37°.1 + 50°.1 + 50°.1 + 37°.1 = 174°.4$$

Calling $p_{e'-e}$ = the probability that the eccentricity should fall within the limits of e' and e we have from loci derived from my Elements II.

$$p_{0.01 - 0.006474} = \frac{100.2}{174.4} = 0.5745$$

$$p_{0.06 - 0.01} = \frac{74.2}{174.4} = 0.4255$$

From which it appears that there are 575 chances in 1000 for the eccentricity to fall between 0.006471 and 0.01; and only 425 chances in 1000 for the eccentricity to be greater than 0.01. If Leverrier was the missing star, the eccentricity by Elements III. was 0.0088107, which is near the middle point of the most probable limit.

I beg leave, in conclusion, to remark, that after a careful examination of all the circumstances known to me at this time, I find none that militates against the hypothesis that Leverrier was the missing star of Lalande.

I subjoin a table of all the stars in the Histoire Céleste situated within 15′ of the locus of Leverrier, (in declination in the above table,) reduced to their mean places for 1800.

No.	Mag.	R. A. 1800	Dec. 1800	
1	9.10	$13^h.50^m.36^s.$	— 9° 24′.0	L_1
2	7.8	13 52 48	— 9 58.8	L_2
3	7.8	13 52 53	— 9 45.7	L_3, B_1
4	8.9	13 57 13	— 10 11.7	L_4, B_1
5	9	13 59 54	— 10 26.4	L_5, B_1
6	8	14 10 0	— 11 26.5	L_6, B_1
7	8	14 12 0	— 11 8.3	L_7, B_1
8	7.8	14 12 09	— 11 20.96	L_8, missing ✳
9	8	14 29 37	— 13 10.7	L_9, B_1

With the exception of the missing star, Nos. 1 and 2 are the only ones not excluded from the hypothesis of identity with Leverrier, by having been since found in Bessel's Zones. No. 1 I reject as too small, and No. 2 I reject as too far south of the computed place. No. 8 was then, before examining the heavens, the only plausible candidate for being missing.

It is possible that the computation of the perturbations for May 10th, 1795, may set aside this hypothesis, though I think it improbable.

Yours, very respectfully,

SEARS C. WALKER.

ARTICLE VIII.

Memoir on the Reproduction of the Opossum. Didelphis Virginiana. By Ch. D. Meigs, M.D. Read March 19, 1847.

Notwithstanding Professor Owen has thrown so much light upon the gestation of the marsupiata, by his publication as to that process in the kangaroo, (macropus major,) I hope a few additional observations that I have had an opportunity to make may be considered as an acceptable contribution to that curious point of natural history and physiology.

It appears to me that both M. Milne Edwards, in his *Elemens de Zoologie,* and M. Pouchet, in his *Zoologie Classique*, continue under great misapprehensions as to the state of the very early marsupial embryo; if, indeed, it deserves any longer to be considered as an embryo, or even as a fœtus: terms which cannot, physiologically speaking, be rightfully applied to a mammiferous quadruped, enjoying in full force all the attributes of a warm-blooded and respiratory existence.

M. Milne Edwards, at p. 265 of his volume on the mammifères, after mentioning the peculiarities of the urethro-sexual canal and wombs, in the marsupials, adds: "Cette disposition entraine des anomalies extrème dans le mode de réproduction des marsupiaux; les pétits ne se developpent pas comme d'ordinaire, dans la poche utérine, mais sont promptement expulsés au dehors, et naissent dans un etat d'imperfection telle qu' on ne peut les comparer qu' des embryons à péine ébauchés. Ce sont des petits corps gelatineux, informes et incapables de mouvement, dont les divers organes ne sont pas encore distincts, et dont l'existence serait impossible si la nature n'avait assuré leur conservation par des moyens particuliers."

M. Pouchet, at p. 262 of the Zoologie Classique, Tome I., says, "Le produit de la generation qui en arrivant la (*the pouch,*) n'est qu' un simple ovule encore baigné de fluides albumineux, se trouve posé sur les tétines. . . . . Ils ne prennent alors de nouriture que par la bouche sans jamais ainsi que l' á émis de Blainville, étre en rapport avec la mêre au moyen d'un ombilic."

I propose to show that M. Edwards and M. Pouchet are both mistaken in their views as to the state of the marsupial young, and that, instead of being little "corps gelatineux, informes et incapables de mouvements," or in the state of a "simple ovule encore baigné de fluides albumineux," it is in the full enjoyment of a powerful respiratory, circulating,

innervative existence, sustained by a most active gastric and intestinal digestion, in which an enormous liver plays its part as completely as in the largest quadrupeds.

The author of a very interesting article on the mammalia in the British Cyclopædia of Natural History, is under a similar misconception—and Professor Owen himself, who seems never to overlook any thing in his vast domain of scientific observation, appears not to have had opportunities of dissecting the organs of the very young marsupial. These are the considerations which lead me to offer to the society the remarks contained in this paper.

Perhaps it might be deemed that the two letters of Dr. Benjamin Smith Barton, Professor of Therapeutics and Materia Medica in the University of Pennsylvania, afford sufficient information upon this curious creature. But I think that though the letter to M. Roume, of Paris, contains much pleasing information, and the other communication to Reimarus, of Hamburg, is full of interest, the two letters together do not clear up some points in the case, which are disclosed by my recent opportunity to observe them, —and, moreover, Dr. Barton's pamphlets are rare—so much so, that I could not obtain an opportunity to examine them until procured by the kindness of Dr. Benjamin Horner Coates, who sent me his copies for perusal.

The Virginia opossum is so very common an animal in the United States, that one is the more surprised at the rarity of its occurrence in the early stages of its pouch life. I have in vain endeavoured, for many years, to procure a specimen of the earliest embryonal form, which, from the difficulty of obtaining it, is fit to be regarded as a zoological gem. I have, on frequent inquiry, found only here and there a person who had seen the young while very small. No one was able to give me information either as to the rutting season, or the duration of gestation—and it is commonly supposed that the young one grows to the teat by a true vascular anastomosis, and that it is indeed formed there in the pouch, ab initio. I have been surprised at the want of curiosity on the subject among the people, and at the total absence of any general opinion concerning the nature of its marsupial life. Many persons living in the country, and who frequently see the animal in the woods and swampy grounds, seem never to have made any inquiries on the subject. Of great numbers to whom I have spoken, I never have met with more than three individuals who had observed the young under two inches in length; and I presume, that of the twenty millions of souls now in the union, there are but few persons who are acquainted with the habits of the animal as to the season of its reproduction, the term of its uterine gestation, and the nature and duration of its marsupial growth. The animal is looked upon as one of the vermin, and hunted, out of a spirit of detestation or contempt.

Some fourteen years ago, I bought, at Camden, opposite to Philadelphia, a female with five young ones; each as large as a half grown rat, and still unweaned. I saw them take the teat, and creep on the mother's back and muzzle, and hold on by means of the prehensile tail, wrapped round her ear, or round her leg. I kept them several weeks in my garden.

In February, 1845, I also procured a female, with two young ones, as large as small kittens, which I sent to M. Flourens, at Paris, where they safely arrived at the Jardin du Roi.

The first named specimens came into my hands about midsummer, while the larger ones, those of 1845, were in the depth of winter. It is probable that the former specimens were weaned in March—and that the latter were nearly a year old, though Dr. Barton thinks they attain full growth in about five months, and he speaks of their weighing eighteen pounds.—Letter to Roume, page 15, note.

I am now in possession of a male and female, for which I am under great obligations to C. W. Sharpless, Esq., who was so good as to cause search to be made for them at his Seat, at Concord, Delaware county, twenty miles south-west from Philadelphia, and to send them to me by a special messenger.

A light snow having fallen on the 18th of February, the tracks of two of the animals were followed to the hollow trunk of a tree, from which they were taken.

I was accustomed, in my youth, to hunt the opossum, as a boyish frolic, and have caught many of them. I never saw two in company, and I believe they are solitary prowlers, except during the season of the copulation.

The fact that they were captured in company, and in the same trunk, leads to the conclusion that they had retired to the concealment for the rut; and this idea is confirmed by the state of the sexual parts of the dam, which were red and very turgid, while the testes of the male were also very heavy and large.

They were taken on the 19th of February, and sent to me on the 27th of the same month. I had them carefully fed, and frequently examined the pouch of the female, in order to discover whether any mammary development might indicate her being in gestation. There was no enlargement of the mammæ on the 27th—not the least—nor was there any on the 28th. I examined the marsupium with care, both by inspection and palpation, on Monday, the 1st of March, and on Tuesday, the 2d; on neither of which occasions could I discover any signs of increase. But on Wednesday, the 3d, the mammæ were visibly and palpably enlarged. They were still larger on Thursday, the 4th, and, on Friday, the 5th, they were hard and swollen. Saturday, the 6th, passed without my inspection, on account of professional engagements, which made my visit to the stable court impossible; but my servant, who had always held her while I examined the pouch, looked into the marsupium, and assured me there was no embryo attached on Saturday.

At 3 o'clock, P. M., on Sunday, the 7th, when I opened the pouch, the young were found at the teats. Here, then, there was a visible preparation made for the reception of the young, in the development of the mammary glands; a fact that serves clearly to refute, if refutation could be necessary, the notion of the Chevalier D'Aboville, cited and scouted by Dr. Barton, that the embryo makes the teat wherever it happens to touch the surface with its mouth. See Prof. Barton's letter to Reimarus, page 19.

The man who had care of her says, that whenever he looked at her, on the Saturday, she was lying on her side, with her nose turned inward between her legs, towards the belly, and she appeared so torpid that he supposed she was sick—the more especially as she scarcely took any notice of his hand when introduced into the box. At all other times she was, and is now, very cross and snarling; and makes a show of defending herself.

It is fair, from the above, to infer, that the uterine gestation terminated on the night of Saturday, the 6th, or on the Sunday forenoon, the 7th of March: sixteen days after the

capture. And now, if we may justly suppose that the fœcundation occurred on or about the 19th of February, we have an inference as to a uterine gestation, of sixteen or seventeen days.

As to the value of this computation I leave naturalists to judge; begging them to bear in mind the extreme rapidity of the mammary development; which commenced on Wednesday, the 3d, and was completed certainly on Sunday, the 7th of March—four days. It seems that so rapid a development of the milk glands ought to be taken as evidence, if not proof, of a rapid uterine gestation.

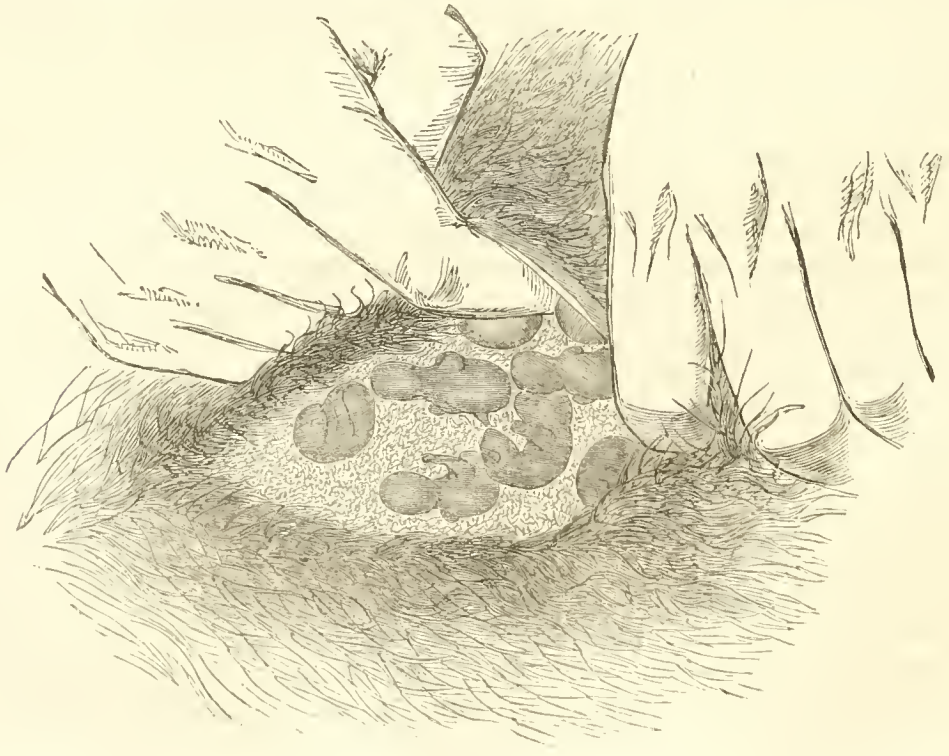
The observation is useful, as settling at least, the question, of one of the reproductive seasons—which is in February, in this instance, and probably in the two formerly mentioned.

Mr. Owen's observation of the gestation of the kangaroo showed, that it came into the pouch on the thirty-ninth day after the sexual congress, which was accurately noted, and which, having been effected thrice in a short space of time, produced only one fœtus.

Mr. Owen does not mention the state of the mammary glands, and seems to have examined only the nipples, which are much less to be depended upon, as signs of gestation, than the glands themselves.

In my opossum I counted thirteen fœtuses, all of them busily engaged in sucking, and freely using their fore-arms, with which they held on to the fur of the pouch—so that to open the sphincter was to see a busy scene of motions.

The figure which I have caused to be made shows pretty well the appearance of the pouch, when held open with two fingers, on the twelfth day.



The young laid on the side—the body strongly flexed; and the delicate mamilla was stretched as it extended from the mamma to the porule which constitutes the stomal orifice.

They were of a deep rose tint; so that the interior of the marsupium looked red, from the hue of their bodies.

It was easy to observe, and to count by the watch, the number of respirations per minute, of the young.

Taking one of the young betwixt the finger and thumb, I pulled very strongly at it; so violently that I feared to tear it in two, at the loins. The connexion was so strong that the head came quite out of the marsupium before it at last let go of the teat, which immediately retreated into the pouch.

When the young one let go its hold the teat was cylindrical, and very long. There was no bulb at the end—it was cylindrical all the way up to the mamma.

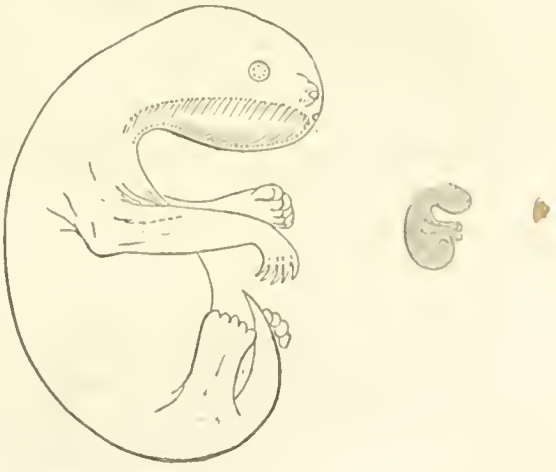
Mr. Owen describes and figures a bulb at the end of the kangaroo teat.

Upon carefully examining the mouth with a doublet, I found that no blood had followed the avulsion, nor the smallest stain; but I feel quite certain that by jerking one off suddenly the lip would be injured and torn; and I suppose that where blood has followed the separation, in other cases, it was produced by too hasty a violence, lacerating the mouth. The pore is so small that it cannot be well made out without a lens. One only sees a shallow dimple. I made one bleed at the mouth by forcing into it the point of a small camel hair pencil dipped in milk—which shows how tender is the tissue in the early stage of existence.

There was not, and had never been, any mesenteric or placentoidal connexion of the mouth and nipple.

I removed this fœtus at forty minutes past 7 o'clock, P. M., and put it in a watch glass, to show it to my friends Dr. Nourse and Dr. Stockbridge, of Maine, and to Dr. J. F. Meigs of Philadelphia.

The adjoining figure exhibits the appearance of the young of the size of nature, with one magnified about five diameters.



It was carefully weighed in Mr. Bringhurst's scale. The weight was just three grains and a half.

In Dr. Barton's specimens the smallest weighed barely one grain; another, barely two grains; and the remaining five, (taken together,) exactly seven grains.—Letter to Roume, page 11. Does this discrepancy indicate that mine were littered on the 5th, and not on the 7th of March?

From the mouth to the end of the tail it was eight-tenths of an inch long.

The fore arm and paw measured one-tenth of an inch in length.

The skin was rose-coloured, and translucent; beneath which could be seen the ribs. No hairs on the skin; which, under the doublet, was wrinkled and very loose.

It moved strongly by means of its fore-arms.

It raised its snout or muzzle off the glass, by the act of extension of its head, and by lifting itself on the fore-paws.

No motions in the hind legs, which are very small; mere buds.

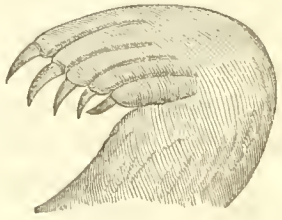
It turned itself over, and moved round the glass in various directions.

It now respired by the two nostrils and by the mouth.

The cartilages of the nostrils seem to be bare, or uncovered, and sit on the anterior face of a conical pit or dimple. It was easy to perceive that the air entered and escaped through all three of the orifices, by the bubbles of milk or mucus resting on the several apertures.

The embryo was dead at ten minutes past nine o'clock; having survived its separation one hour and twenty-nine minutes, during which it carried on a true respiratory, pulmonic life; notwithstanding it had been much handled, and exposed to the cold air of the street.

There were no nails on the hinder toes; those of the fore-paw are faithfully represented in the figure annexed. They were of a red hue.



The iris was very visible, of a faint blue colour; no appearance of any palpebral raphe; the organ of vision quite covered beneath the skin—through which it is seen.

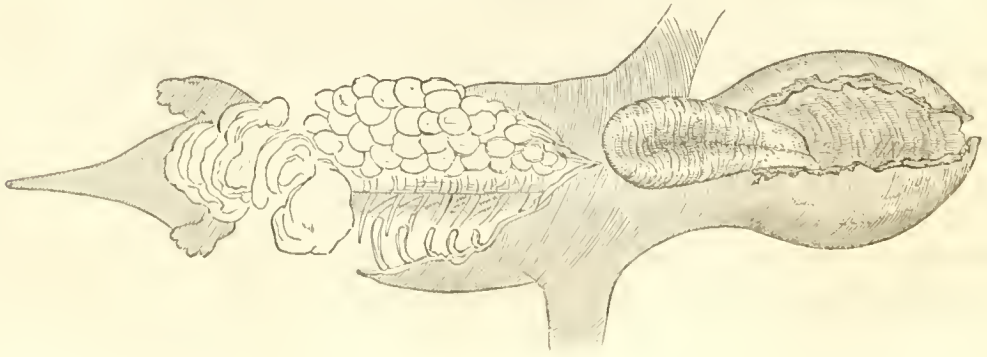
No orifice of an ear—but a whitish-coloured cicatrice or scar, beneath which the organ is hidden.

No raphe of the lips, running towards the angle of the future enormous mouth, or gape.

I have already given the measure of the fore-arm; which possessed the power of pronation and supination very perfectly.

The paws were very prehensile.

I pinned it, on its back, to a flat cork, and completely extended it. Introducing a dissecting needle into the mouth, I split with it the lip, lower jaw, and throat, down to the sternum—when I discovered a vast milk-white tongue—so enormous, in proportion, as to convince me that the tongue alone constituted fully one-third of the entire weight of the head. See its outline in the former figure, and in the one annexed.



The figure may be depended on as correct for the form and proportion of this unique organ, turned downwards to the breast. It was white, as a clot of milk. It was turned up on the margins, so as to make of the tongue a complete groove, for the lodgement of the nipple—the palatine vault being the superior half of a flask-shaped cavity in which the mammilla being once lodged and engorged, by the act of sucking, is permanently detained within—for it is difficult to draw the teat again through the porule, or stomal orifice.

I was led to examine the tongue because I perceived that the animal was possessed of a strong suction power; for I had several times touched the stomal dimple with the smooth, rounded point of a drawing-pencil, and the creature sucked it so strongly that I could draw it round the glass with the point, and even lift it partially off the surface by the pencil.

It is a very curious sample of the adaptation of the development forces of the animal economy to the attainment of a special and transitory end. I find that as the embryos proceed in their organic development, the tongue becomes rapidly smaller in proportion. In the dissected specimen on the table, the tongue, though vast, is much less, relatively, than in the first specimen.

Does this fact, that the embryo of twenty-four hours' marsupial life could attach itself, by suction, to the end of my pencil, throw any light on the manner of its primary adaptation to the nipple, or of its power to find and seize it, while groping within the marsupial cavity?

I wish to be understood as saying, that I could not clearly make out the mouth without a lens, though I could perceive the dimple which led to it.

When I had split the under jaw and turned the tongue downwards, it was easy to see that the palato-glossal cavity was large, and that the nipple once freely drawn into the fauces must become, in a degree, strangulated. The constant suction would prevent it from inflaming or sloughing.

The young animal adheres to the teat both sleeping and waking, and never lets go until the marsupial gestation is at an end.

The mechanism of its adherence is very intelligible. The delicate nipple being drawn within the stomal pore and acted on by the immense tongue, becomes engorged, and cannot be withdrawn, except by such violence as I used. Its escape from the orifice cannot take place suddenly, without lacerating the lips. When it is slowly withdrawn, it becomes gradually disengorged in the process; and very certainly does not exhibit any bulb at the end—or in the whole tractus of the teat; as represented by Mr. Owen in the kangaroo teat. Its attachment is on the same principle as that of the female to the dog in copulation.

I very carefully sought, with a good doublet, for any vestige of an umbilicus, both in this and in later specimens, without being able to discover any such mark of a former placental union. I conceive that the absence of vestigia ought not in the least to awaken any doubt as to the antecedent placental union of the embryonal animal. The less, inasmuch as it is, at the end of the first day of its respiratory existence, found to be so far developed as to deserve being regarded as a living, independent creature, and not as an embryo, as I before remarked. Now I cannot perceive any reason to believe that a

healthy, warm-blooded mammifer can possibly be developed but by means of a placental or placentoidal apparatus—and I repeat that the absence of all traces of it in my specimen ought not to disturb my faith in the invariability of the genetico-generic laws. A mammal is, ipso facto, a placental animal.

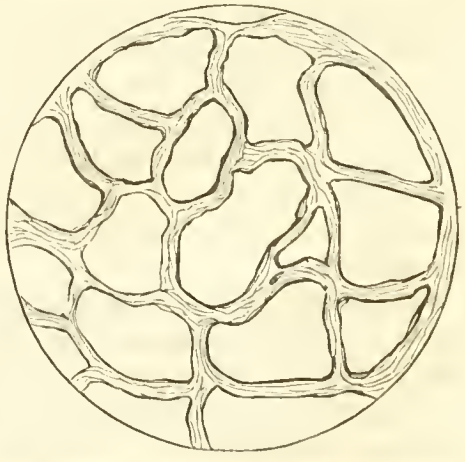
Having the animal well secured in a dorsal decubitus, I opened the abdomen with a dissecting needle, taking care not to wound any of the interior structures. There was much fat under the dermal surface. The skin was slightly adherent. The tela cellulosa is extremely delicate in these early stages of existence. I found that the muscles of the tongue and those of the abdomen were readily displaced out of their cellular sheaths, by raising and removing them with the point of a dissecting needle.

I opened the thorax with a delicate scissors, and found the sternum and the ribs very stiff and elastic, cutting like cartilage. I presume no phosphate was as yet deposited, at least in those organs.

The sides of the abdomen and thorax being cut away, allowed me to inspect, with the lens, a most beautiful and perfect set of organs, as the heart, with its pericardium; the liver; a very large and loaded stomach; and a considerable tractus of intestines, all filled and plump with fulness.

I was much struck with the appearance of the lungs. On each side of the heart I discerned a number of *bubbles*, which, on closer investigation, proved to be spherical air-vessels, or pulmonary vesicles full of air. They rather resembled a bunch of transparent hydatids or grapes, or a collection of fine soap bubbles. I have given a magnified view of these vesicular lungs in the last figure.

I removed some of those of the left side, and placing them on my microscope, viewed them with a power of one hundred and fifty. They were pressed beneath a plate of mica. The figure shows the microscopic appearance of the compressed air-cells. The intervesicular tissue was manifestly organized, and of a brownish tint; not a mere sarcode. I did not see any blood-vessels. I presume the blood had escaped, for I had taken it up with points of blotting-paper, out of the thoracic and abdominal cavities, in order to have a clearer view.



The lungs were *very* large; and the quantity of air contained within them must have been vast, as compared with the wants of aeration for the few drops of the creature's blood.

I am not aware that Mr. Owen and Mr. Edward Queckett have as yet resolved the question whether the swimming bladder of fishes is also a true organ of aeration. Mr. Queckett was making researches on that point in 1845, when I had the pleasure to see him in London; and I sent to him some specimens of the gar-fish of the western rivers, with a view to his inquiries on that very head. If those naturalists have discovered that the swimming bladder is an organ of aeration, then I cannot but think that my marsupial didelph is as amply supplied with

means of oxydating its blood as the most active and powerful dolphin or sturgeon—and I cannot imagine that even the profuse supply of tracheæ in the annelides can exceed in liberality the oxygen endowments of the young opossum of three and a half grains' weight.

Many have doubted whether the young is not attached by a vascular union to the teat —an idea that has been put forth by high authority. Mr. Owen, however, has set that matter in a clear light.

Nevertheless, I resolved to ascertain whether any milk was in the stomach, and therefore removed that organ, and putting it under a compressor to squeeze out the contents, examined them with one of Oberhaeuser's instruments, under a high power. The vesicles of the milk were innumerable. Dr. Barton, page 8, in a note, says, "In an opossum weighing only forty-one grains, I have seen the stomach very considerably extended with a white matter, or milk. But the milk that is afforded to the embryons for a few days after their first reception into the marsupium is nearly pellucid or transparent."—Letter to Roume. So that the animal sucks and swallows milk, and fills its intestines, and makes chyle, and has a powerful hæmatosis, and a vast aeration, with muscular and organic innervations, at the end, or sooner, of one day's marsupial life! the weight being three and a half grains.

It is quite apparent that M. Milne Edwards and M. Pouchet are wrong in their opinions as to the forwardness of the vital organs in this early stage; and all my astonishment and doubt as to the state of the development and the means of living in the marsupial didelph are quite at an end—as I find there is nothing in it different from what occurs in the young child at its mother's breast.

Monday, March 8th.—Upon opening the pouch to-day, I observed the young moving their arms and bodies freely, each one busy at its needful work; pulling and even tugging at the nipples. They occasionally slowly extend the body, and then, by a sudden start, or jerk, flex it again, after the manner of a shrimp or cray-fish.

Wednesday, March 10th.—The young considerably larger—all at work.

Saturday, March 13th.—The pouch opened at 5, P. M. Young are much grown and very frisky. I counted twelve of them at the nipples.

Sunday, March 14th, 4 P. M.—I removed a young didelph, which adhered so strongly that the nipple was drawn quite forth of the sac before it let go. On the nipple, again, was no bulb, but it resembled the figure.

The animal now weighs twelve grains in Mr. Bringhurst's scale. Seven days ago it weighed three and a half grains; an increase of about two hundred and fifty per cent.

Its whole length, one and one-tenth inches; when flexed, six-tenths.

No hairs on the rose-coloured skin, which is more wrinkled than before.

At twenty minutes past 7, P. M., which is three and a half hours since I took it off, it breathes thirty-two per minute, by the watch—very regularly—the counts repeated several times.

Sleeps and wakes by turns on the lock of cotton where it lies. External organs and scrotum large.

At 11, P. M. it was still alive and strong, and, I doubt not, might live until morning, or longer. I now suspended it in alcohol, in which fluid it continued to move its body and arms for five minutes, and then died. I sent it to Professor Louis Agassiz, at Boston.

Tuesday, March 16th.—No hairs on the young, which are grown considerably, and quite strong and lively.

Thursday, March 18th, twelfth day.—The figure represents truly the opened marsupium. I removed an embryo, which held on more strongly than the others. Its weight, in Mr. Bringhurst's scale, is 18 grains; which is more than four hundred per cent. of increase.

Flexed .75 of an inch long; extended, from snout to tail, 1.25 inches.

No hairs.

Skin very loose and wrinkled. It seems to me that the development of its derm is much more hasty than that of any other tissue—as if it were the forerunner of the organs, growing more rapidly than they, in order for their accommodation. Nails begin to grow on the hind toes. Intestines visible through the still translucent, rose-coloured skin.

Scrotum large.

Motion of tongue and also of the inchoate lower maxilla visible in sucking; which I noted as it imbibed and swallowed milk from the end of a camel hair pencil moistened with milk. The point of the pencil seen through the translucent cheek within the mouth.

The outer ear of an oval lenticular form, whitish, is still closed, being completely covered with skin.

Globe of the eye seems much larger; no palpebral raphe in the covering skin through which it is seen, and which permits me to see the globe rolling in various directions. The motores oculorum muscles are therefore developed to-day.

Fore-arms and paws very strong. He gropes and pinches up the skin of his buttock with his finger-nails, and seizes his tail, which he pulls with his hand. In the pouch he held on to a handful of fur, which he grasped, in order the better to tug at the nipple.

The tail highly prehensile. It wraps itself over the point of a pencil, and suspends him in the air. He can suspend himself by the final twentieth of the organ.

The mouth begins to assume a slit-like form; and is not so dimple-like as at first.

The raphe of the lips extends far back.

I put it in a cup of alcohol. It continued, during its immersion, to move freely and strongly for sixteen minutes, by my watch, and then was apparently dead.

I now adjusted and secured it on the back, for dissection.

There was much fat beneath the skin, on the belly and thorax. ("Fat as a 'possum," is an American saying.)

When I opened the thorax I found the heart beating very evenly; and although I dissected it nearly all the time, so as to remove the sides of the chest, and the abdominal parietes, and opened the throat, and turned and fastened the tongue down with a needle —the heart continued to pulsate until twenty-five minutes past eleven o'clock, one hour and a half after its immersion in the alcohol.

I take this fact as a proof of the powerful vitality of this creature. Such a fact was not wanting to show the liberal endowment of its organic material with life force—

lebenskraft—since, but for such special endowment, its placentoid would not be so early exchanged for its pulmonary and gastric sources of nutrition and oxygenation. Probably all the marsupiata are endowed with extraordinary tenacity of life.

The liver is immense.

The diaphragm strong.

Lungs still vesicular and bubble-like, but less so than in the earliest case. The pulmonary organ is evidently acquiring greater consistence, and a more visceral or parenchymatous character.

Many large sanguiferous red vessels seen on the skin on each side of the neck, ramifying on the head—along the arms; on the sides—and on the dorsal aspect of the tail, with arterioles, or venules branching from them.

The heart in a strong pericardium, more on the left side. Heart and pericardium together near three-twentieths of an inch in length.

Liver very large, of a dark hue, extends far over on the left side; from beneath which half peeps the distended stomach.

Intestines very full, and yellow-tinted, from the yellow gall mixed with the milk of the convolutions. Hence the animal already has a biliary apparatus for abundant secretions of bile. Dr. Thomas Schwann has shown, by his experiments on the dog, that bile being absent, the animal becomes atrophied. How fully is this creature endowed with all the means of nutrition, both of apparatus and elements!

The members of the society have now an opportunity to examine the dissected animal, now on the table, and may see that the representation in my drawing is correct.

The mode of arrangement of the stomach and intestines will be found as in the figure.

The bladder of urine large, and full—very white.

The tongue has become relatively smaller than in the first case.

It is thought very desirable that some proofs should be forthcoming as to the method or machinery by which the young are transferred from the uterine to the marsupial gestation.

I believe this desideratum, if it really be one now,—will never be attained. It is clear that the paw of the dam cannot do it; the vulva cannot touch the orifice of the pouch; the young cannot creep to the pouch. It remains, then, that the lips of the dam are used to place them.

I shall trespass no longer on the patience of members, than by offering the remark, that these researches appear to clear up a lingering doubt and uncertainty as to the nature of the earliest marsupial life. They show it to be a chylopoietic, warm-blooded, oxygenating, innervating, and free-willing life; and that all the means of carrying on an independent life are as fully enjoyed by the marsupial fœtus, as by the young of the elephant at the teat, or the balæna mysticetus, which is said, at birth, to be twenty-seven feet in length. If that be so, all mystery as to marsupial life is at an end—save that useless one, of the machinery of adaptation to the nipple.

Whether she merely deposites them inside of the marsupial sphincter, leaving them to find the nipple instinctively—which is probable—or whether she applies them herself—which is an incredible accuracy of contact and perception—no man can ever know, since

her muzzle will always be concealed within the marsupium, while engaged in the work, if she herself does that work. I should think the delicate touch of a watch-maker alone fit to make the adjustment—so small is the stomal porule;—it is much more likely that the young find the nipple in the incessant groping of the point of the oviform head.

Mr. Owen saw his kangaroo put her nose within the pouch, and lick its edges—no one will go farther in this discovery than that distinguished and admirable person has gone.

My observation of this case does not settle the question of the duration of the uterine gestation, though it will approximate it to the sixteenth or seventeenth day. Professor Barton, in his letter to Mons. Roume computes it at from twenty-two to twenty-six days. upon I know not what authority. Mr. Owen has convincingly shown that the kangaroo carries in the womb thirty-nine days, post coitû.

The rutting season here was in February. Professor Barton's didelph, which had five young ones, as large as rats, two-thirds grown, when he bought them, on the 14th of May, brought seven embryons into the marsupium on the 21st of the same month. He says the uterine gestation is between twenty-two and twenty-six days, and that of the pouch about fifty days; at which time they attain the size of a common mouse.—Letter to M. Roume, T. & S. Palmer, Ph., 1806.

Mr. Owen's kangaroo had been giving suck to her young one just before the embryos came into the pouch—which is evidence of a coincidence in the reproductive habits of these two marsupials.

As the five young ones which Dr. Barton procured were as large as mice, and freely running about, they must have been some time detached from the marsupial life. But as he says they are twenty-two days in the womb and fifty in the pouch, and in his specimens, probably at least thirty days out of the sac, we have the inference that the conception took place one hundred days before the 4th of May; we suppose about the 24th of January, and the second conception about the first of May. So that it may be the rutting season extends from January to somewhere in May, say five months.*

I shall endeavour very carefully to determine the duration of the marsupial life, and should the definite facts come into my possession, I shall beg leave to communicate them to the society in a supplementary note to this memoir.

Addition.—Tuesday, May 11th—The sphincter marsupii cannot contain all the young in the pouch—the half of two bodies hanging outside. No hair on the young animals. They do not let go the nipple, this sixty-eighth day of marsupial life.

Thursday, May 20th—Young still undetached; eyes still unopened. No reason to suppose they have ever let go. This is the seventy-second day.

Saturday, May 22d—An embryo was crawling on the body of its dam; eyes slightly open. It weighs four hundred and twenty-eight grains; having gained four hundred and twenty-four and a half grains, since the 7th of March, seventy-four days ago.

* A gentleman from Alabama says he has seen the very small marsupial young, in October, in that state.

ARTICLE IX.

On some of the Results of a Series of Experiments relative to different parts of Gunnery. By Captain Robert F. Stockton, of the United States Navy. Communicated by Professor Henry. Read June 19th, 1846.

The experiments of which the present communication is intended to give an account of some of the results, were instituted by permission of the Navy Department, and were supplementary to those previously ordered, by the same authority, to be made with the large guns of the steamer Princeton.

The results now presented to the society relate to the three following questions, viz.

1. Is a gun more liable to burst with a space left between the powder and shot, than when the latter is rammed home?

2. What is the effect, in reference to the tendency of bursting, of increasing the number of shot to be fired from the gun at the same discharge?

3. What part of the gun is exposed to the greatest internal pressure from the explosion of the powder?

I. It has been stated by the highest authorities on gunnery, and it seems to be generally admitted, that a space left between the powder and the ball greatly increases the danger of bursting.

"If," says Mr. Babbage, in his interesting work on the economy of manufactures, "in loading a gun a space be left between the wadding and the charge, the gun either recoils violently or bursts." This opinion appears to have been first advanced by Robins, and was based on some incidental observations made in the course of his experiments on gunnery. Various hypotheses have been proposed for its explanation. Mr. Babbage refers it to the difference of time in the passage of a wave, or the effect of an impulse, through air and through metal. Poisson, we believe, adopts the same explanation, while Robins attributes the effect to the momentum which the generated gas acquires before it reaches the ball. If the first explanation be true, it is difficult to see why a gun should not burst as readily without a ball as with one; and, in the second explanation, we are at a loss to conceive how a sufficient momentum can be generated in a gas moving in a

space already filled with common air. None of the high authorities we have mentioned appear to doubt the truth of the fact which, from its paradoxical nature, and the contradictory explanations which have been given of it, would seem to require a more substantial basis than that on which it appears to rest. The experiments of Robins were on a small scale, with a musket barrel, and none of them appear to have been instituted expressly for the purpose of settling the point in question. It is true that the opinion would seem to be supported by common observation, for undoubtedly guns do burst more frequently in cases where the ball is not down on the powder, than under other circumstances, but it should be recollected that the bursting, in every instance of this kind, may be due to the fact that the ball is too large for the bore, and that in attempting to force it down, it becomes wedged in the gun, and thus its resistance to dislodgement is materially increased. A comparatively small force applied to push down a ball too large for the bore, would convert a portion of its spherical surface into the form of a cylinder, which, by increasing the points of contact, would increase the resistance: we are aware of the fact that ordinary friction does not increase with an increase of rubbing surface, the total pressure remaining the same, but in the case of the ball the increase of the surface of contact increases the wedging, which must increase the resistance in the same proportion. From the foregoing considerations, the author of this paper was led to doubt the truth of the proposition, and to institute a series of experiments which should give it a more thorough test than any to which it before had been subjected.

For this purpose, a number of guns, of a calibre two inches in diameter—thirty-five inches long; of a uniform thickness of metal of one inch around the bore, and two inches of solid metal behind the bottom of the cavity, were cast from the same fount of iron—and were, consequently, nearly of the same strength. The weight of each was between ninety-three and ninety-six pounds, and they were secured, in succession, to a large block of timber, for the purpose of bursting. The charge consisted of cannon powder done up in the usual way, in light flannel cartridges; no wads were used, and the ball covered with a coating of felt, to lessen the windage, was placed in contact with the end of the cartridge, or at different distances from the same, the intervening space being occupied only with air. In all cases of a variation in the charge of powder, an increase was made of one-fourth of an ounce each time, until the desired effect was produced. The following are the particulars of the several experiments.

1. In the first experiment, the bursting of the gun took place at the first discharge, with seven ounces of powder, and the ball in contact with the cartridges. A smaller charge would have been first used, had it not been supposed, from some previous experiments with another set of guns, that this piece would have stood the quantity of powder with which it was loaded.

2. In another gun, the ball was constantly placed in contact with the cartridge. The firing was commenced with five ounces of powder, and the bursting took place at the fifth discharge, with six and a quarter ounces.

3. The ball in the next gun was placed first at twelve inches from the powder, then at four inches, and lastly in contact with the same. The experiment commenced with six ounces and a quarter of powder, and the explosion took place at the sixth discharge, with

six ounces and three quarters, the ball being in contact with the cartridge. It will be perceived, by this experiment, that the gun had, previous to bursting, withstood the force of two discharges of the same quantity of powder, with the ball at a distance from the cartridge.

4. In the next gun, the ball each time was placed at the distance of two inches from the end of the cartridge; the charge was regularly increased from six and a quarter ounces, and the bursting took place at the seventh discharge, with eight ounces of powder.

5. In the next experiment the ball was constantly placed at the distance of six inches from the end of the cartridge, and the charge regularly increased until the bursting was produced, with nine ounces and three quarters of powder.

6. The ball, in the next experiment, was placed alternately at the distance of twelve and four inches from the cartridge. The firing commenced with six ounces of powder, and was regularly increased until the gun burst. The last charge was seven ounces and three quarters, and the ball at the distance of four inches from the cartridge.

7. In the next experiment, the gun was loaded with two balls, placed at the distance of twelve, and four inches from the cartridge, and also in contact with the same. The balls were fired in succession, with the same charge, from each position, and when the process was repeated with an increased charge, the bursting took place at the sixth discharge, with four and a half ounces of powder, and the balls in contact with the cartridge. In this case also the gun burst, after having withstood previously two discharges of the same quantity of powder, and a space between the balls and the cartridge.

Another set of guns had previously been cast of the same weight and dimensions of those we have described, but of metal of finer texture, and greater tenacity. In reference to the question under consideration, two of these guns were burst in succession; the following are the particulars and results:—

1. The first was charged in succession with one ball, placed in contact with the powder, the charge being regularly increased from seven ounces. The bursting took place with nine ounces and a quarter.

2. The other gun was fired in succession with the ball placed at the distance of twenty-one inches and nine inches from the cartridge, and in contact with the same. The experiment began with a charge of seven ounces, and the bursting was produced with eight ounces and three quarters, the ball being in contact with the powder.

The general results of these experiments are the same as those with the other set of guns. The bursting took place with the ball in contact with the powder, and in both cases after the gun had withstood two discharges of the same quantity of powder with a space between the cartridge and the ball.

The following is a recapitulation of the results with the first set of guns.

With shot rammed home, from the mean of three experiments, the bursting charge was $6\frac{3}{4}$ oz.
With space of two inches, bursting charge, ... 8 oz.
With space of four inches, ... $7\frac{3}{4}$ oz.
With space of six inches, ... $9\frac{3}{4}$ oz.

(1.) By an examination of all the results, it will be seen that the guns invariably burst with a smaller charge when the ball was nearer the powder than when it was at a distance. The average bursting charge from three sets of experiments with the balls in contact with the powder is six ounces and three quarters; while, with a space between, the average charge, to produce the same effect, is eight ounces and a half.

(2.) In three cases of the four guns in which the position of the balls was varied, the bursting took place with the ball in contact with the powder after the gun had twice sustained the force of the discharge with the same quantity of powder with a space between the ball and the charge; and in the fourth case, (experiment 6,) in which the ball was placed alternately at the distance of twelve and four inches, the bursting took place with the shot at the shortest distance, after the gun had previously withstood the same charge at the greater distance.

It may be mentioned, that the range or distance to which the ball was thrown horizontally, before striking the ground, was greater in all cases where the shot was down on the powder than in those in which a space was left between, also when the shot was in contact with the powder, the recoil, as indicated by the motion of the timber to which the gun was fastened, was less than when the shot was rammed home. This result is also at variance with the popular belief in reference to the subject. From these results it therefore appears, that so far from increasing the tendency of a gun to burst by leaving a space between the ball and the powder, the danger is considerably diminished by such an arrangement.

II. In reference to the second question, the effect of increasing the number of shot, we have the following results from the two sets of guns:—

From the first set.

1. With one gun charged with a single ball in contact with the powder, the bursting charge was six ounces and two-thirds.

2. With another gun, with four balls, all home, the bursting charge was three ounces and three-fourths.

3. With the next gun, charged with nine balls, all home, the bursting charge was three ounces and a quarter.

From the second set.

1. The first of these guns was burst without shot, the quantity of powder being regularly increased, the effect took place with sixteen ounces.

2. Another gun, charged with one ball, in contact with the powder, burst with nine and a quarter ounces.

3. The next, also with one ball in contact with the powder, burst with eight ounces and three quarters. The average of the last two being nine ounces.

4. Also another gun of the same set, charged with two balls sent home, burst with six and a half ounces.

5. Another of the same set, loaded with five balls, all home, burst with four ounces.

By a comparison of the last set of experiments made with the guns of greater tenacity of metal, it appears that the bursting charges are nearly as the square root of the number of balls inversely. And this would seem to be in accordance with the well-established fact, that, with a constant pressure, the time required to move a weight through a given distance, is as the square root of the weight.

The results of the experiments with the first set of guns are in general the same as those from the second set, although the deviation from the ratio of the square root of the number of balls is more considerable. The variation, however, is not greater than what might be expected from experiments of this kind. It will be perceived that some of the results of the experiments which were given under the head of the first question are repeated under the present head, and it may be proper to add, that the whole number of guns burst in these experiments was fourteen, and the number of discharges about three hundred.

III. In reference to the third question, namely, what part of the gun is subjected to the greatest internal pressure at the moment of the discharge, the following experiments and observations are offered. For the purpose of ascertaining the relative pressure on the different parts of the interior, a series of holes were drilled through to the bore along each side of a number of the guns, and to these holes, in succession, a barrel six inches long was strapped, at right angles to the length of the piece, so that the velocity of the ball from this barrel, in different positions, would give the pressure required. The holes were six inches apart, and in order not to diminish too much the strength of the gun, those on one side were made in the middle between those on the opposite side. The gun was immovably fastened to a large block of timber, and to determine the velocity of the ball from the short barrel, and consequently the internal pressure, the whole was accurately levelled, and a horizontal line drawn at the height of the axis of the gun, on a target of pine plank placed at the distance of ten yards. The deflection of the ball from this line being accurately measured by its mark on the target, the time of flight, and consequently the velocity, could be approximately calculated on the principles of falling bodies—also, for the sake of comparison, with the results furnished by the deflections, the depths of penetration of the balls into the pine plank of the target were accurately noted. The charge of the gun in all the experiments was the same, and consisted of two ounces of cannon powder, and one ball, placed in contact with the end of the cartridge. The holes were along the whole length of the bore of the gun; the first one being at about two inches from the end of the bore and a little behind the centre of the ball. Ten discharges were made in succession with the lateral barrel opposite the same hole, and the average distance of the marks of all the balls on the target below the horizontal lines was taken as the measure of deflection. The series with each hole was several times repeated until the whole number of shots fired exceeded a thousand.

The general result was, that the least deflection and the greatest penetration were produced when the side barrel was fired from the hole nearest the powder—that the velocity diminished, in a ratio not determined, as the barrel was advanced towards the muzzle.

From these results it is inferred that the greatest internal pressure is on that part of the gun occupied by the powder, and as a fact in accordance with this inference, it may be mentioned that in all cases of the bursting of a gun, the fracture was confined to the part between the bottom of the bore and the position of the outer side of the last ball. The solid britch end was always broken short off at the bottom of the bore, and presented in every instance a remarkable similarity of appearance. Looking in the direction of the axis of the bore, the surface of fracture of the solid end was seen divided into three nearly equal sections, by three ridges nearly in the direction of the radii, with concave surfaces between them. From an examination of all the fragments, the fact appeared to be established that the fracture always began in three lines near the britch, but that, on advancing towards the muzzle, it frequently wedged out into four, and sometimes more, lines.

A number of other questions have occupied the attention of the author of these experiments, and the other results of his investigations may, perhaps, be hereafter presented to the society, should the present article be deemed of sufficient interest to warrant another communication of a similar character.

ARTICLE X.

On the decomposing power of Water at high temperatures, by Richard A. Tilghman.
Read August 20, 1847.

It has long been noticed, that partial decomposition is often effected in attempting to render anhydrous, by heat, certain salts which require a comparatively high temperature for the expulsion of their water of crystallization. This effect is not limited to those salts which are capable of decomposition by the action of heat alone, but extends to many which, when previously rendered anhydrous, are entirely unaffected by this agent. The chloride of magnesium offers a striking instance of such an action, being almost entirely reduced to magnesia, with escape of hydrochloric acid, when its solution is evaporated by a strong heat; the anhydrous chloride, when obtained by other processes, is, on the contrary, unaffected by the highest heat.

Even chloride of calcium, a salt of a much stronger radical base, has been observed to give off a portion of acid, when all its water of crystallization is driven off by a red heat. In these and many other instances, it seems evident that the escaping water of the salt is the actual decomposing agent, and that the intensity of its action depends solely upon the degree of heat which the salt can sustain before giving it off.

Contact of the salt and water, at high temperatures, appears to be the only requisite of decomposition. It was, therefore, thought probable, that by exposing the salt, even in its anhydrous state, to a high heat, and passing over it a current of aqueous vapour, raised to a similar temperature, not only might the above-mentioned salts be completely decomposed, but also that many others which have hitherto given no such signs of partial decomposition, might be acted upon in a similar manner.

On making the experiment, it was found, that not only the anhydrous chloride of calcium, but also the chlorides of strontium and barium could be rapidly decomposed by exposing them, at a high red heat, to a current of steam; hydrochloric acid was copiously evolved, and escaped along with the excess of steam, while the bases of the respective salts were left in a free state; the lime remaining anhydrous from the intensity of the heat employed, while the baryta and strontia combined with a portion of aqueous vapour, and were found in the state of hydrates.

In these haloid salts, it is to be observed, that the addition of the elements of water is absolutely essential to the decomposition; as neither the hydrogen which is contained in the acid, nor the oxygen in the base, existed in the anhydrous salt. The action is, therefore, the result of a double decomposition between the steam and the chloride, as well as of the affinity of the liberated acid and base for water.

The oxysalts, the sulphates of magnesia, lime, strontia, and baryta, unlike the haloid salts just mentioned, contain, even in the anhydrous state, all the elements generally considered necessary for the separate existence of the acid and bases of which they are composed. The application of the strongest heats to these salts causes, however, no liberation of their acid; but, as with the chlorides, this effect is immediately produced by the passage of a current of steam over them at a high temperature, the baryta and strontia being left in the state of hydrates, and the other bases anhydrous.

The intensity of the affinity between the acid and base of the respective salts, is curiously illustrated by the gradual increase of the heat necessary for their decomposition by the aqueous vapour.

Thus the sulphate of magnesia gives off its acid to the current of steam at a low red heat, and consequently a large portion of the acid may be condensed in an undecomposed state. The sulphate of lime requires a high red heat for its decomposition, and on this account the greater part of its acid is resolved into sulphurous acid and oxygen gas. The decomposition of the sulphates of strontia and baryta, requires progressively higher heats, which, in the case of the last salt, must be raised even to low whiteness.

The subphosphate of lime, as it contains an acid much less volatile than sulphuric, combined with an excess of a powerful base which adds to its stability, was selected as one of the most difficult tests of this decomposing power of aqueous vapour: by a full white heat, however, its phosphoric acid was slowly disengaged. This phosphoric acid gave a white precipitate with nitrate of silver, showing that its liberation and subsequent condensation in contact with a great excess of aqueous vapour, had not prevented that change which heat is known to produce upon this acid.

It might be expected from the decomposition of the salts of baryta, that the sulphates and muriates of potash and soda would undergo the same change with even greater facility. But it was found, by experiment, that although the decomposition of these last salts commenced with facility, when they were exposed to steam at a red heat, yet the proportion of alkali thus liberated never exceeded a very small per centage of the residual salt, however long the operation might be continued. Attributing this peculiarity to the volatile nature of the liberated hydrates of potash and soda at high temperatures, substances capable of forming non-volatile combinations with the alkalies were mixed with their salts, previously to subjecting them to the action of the steam; the acids were then found to be completely disengaged with facility. The fact that both lime and magnesia, substances capable of forming chemical combinations of but the most feeble character with potash and soda, were found to produce the above effect, was considered as confirming, in a great measure, the hypothesis that the volatility of their hydrates was the cause of the apparent difficulty of completely decomposing the salts of these alkalies.

The subphosphates and subsilicates of lime, baryta, and strontia, act in the same man-

ner as lime and magnesia, and in all these cases the chemical combination is so feeble that, when cold, the alkali is disengaged by the solvent powers of water alone.

Alumina, which possesses so much of the acid character with respect to the strong bases, is proportionably more efficient than any of the preceding substances in aiding the decomposition of the alkaline salts: it remains in combination with the alkali, when cold, as a soluble aluminate; but is easily precipitated from its solution by a current of carbonic acid gas.

The calcination of potash alum leaves a mixture of alumina and sulphate of potash, which Berthier has long since stated to be converted into aluminate of potash by the continued action of heat alone, the sulphuric acid being expelled from the potash by the superior affinity of the alumina at a high temperature. By several careful repetitions of his experiment, in which the accidental presence of aqueous vapours was entirely prevented, no decomposition of this kind could be effected, even at a white heat. But by the contact of aqueous vapour, produced by the combustion of the fuel or otherwise, even in small quantity, and at much lower temperatures, the decomposition is rapidly produced. It, therefore, seems probable that the accidental contact of aqueous vapour was the actual but unnoticed cause of the decomposition in Berthier's experiment.

The powerful action of aqueous vapour upon anhydrous alum at a high temperature, suggested the possibility that a similar action might take place upon its mineral representative, the double silicate of alumina and potash, or common felspar. It will be remembered that this salt, by the simple substitution of sulphuric for the silicic acid which it contains, would be converted into anhydrous alum. To the action of heat alone, felspar presents this difference from alum, that the silicate of alumina is as unaffected by it as the silicate of potash itself; so that to produce an effect upon felspar analogous to that upon alum, the silicic acid of both the silicate of alumina and of the silicate of potash would have to be removed. Silicic acid, in a *free* state, having been long known to be slightly volatile in aqueous vapour at high temperatures, it was thought that, in the present case, it might, like the other acids, be disengaged even from a state of chemical combination, by the same agents. Steam was, therefore, passed slowly, for some time, over small fragments of highly heated felspar. Beyond partial fusion, no other visible change than a considerable degree of vesicularity in the parts most exposed was produced. These fragments, being finely pulverized and boiled in water, the concentrated solution was strongly alkaline, and proved, by the usual tests, to consist of aluminate of potash.

After water ceases to extract aluminate of potash from the powdered mineral, dilute sulphuric acid will produce from the residue a small proportion of alum. The actual analogy between alum and felspar, substances so distinct in their origin and general properties, yet differing only in the nature of their respective acids, is rendered still more striking by both thus yielding the same product, when deprived of their acids by the same agent. It is worthy of remark, that, although the actual contact of the steam in this experiment is confined to the mere surface of the small fragments of felspar, yet the chemical decomposition produced by it is not confined to that surface, but spreads by a

"cementation action," through their entire mass: pulverization is, therefore, required to obtain evidence of the internal change which has been produced.

All the experiments, so far made, would indicate that the following was the general rule applicable to all salts capable of sustaining heat alone without decomposition.

Whenever a salt, from its own elements alone, or by the addition of those of water, can produce a volatile acid and a fixed base, the evolution of this acid and the liberation of this base will be determined by passing a current of aqueous vapour over the salt raised to a high temperature. When either the acid or base to be liberated forms a combination with water which can resist decomposition by the heat employed, the tendency to form such hydrates adds much to the decomposing power of the aqueous vapour. Although potash and soda are not by themselves fixed bases at high temperatures, yet by the use of the substances before mentioned, they can form combinations which are fixed, and by this means their salts come under the above rule.

The actual number of salts which have as yet been subjected to this mode of decomposition, is not very large; yet, from their perfect analogy of composition with many others, there can be but little doubt of the general extension of the principle.

The chlorides of potassium, sodium, barium, strontium, and calcium, being all thus decomposed, the bromides, iodides, and fluorides of the same and all weaker bases, must probably act in the same manner. The fluoride of calcium has, in fact, been found to do so, by experiment, hydrofluoric acid being freely evolved. In the same manner, from the decomposition of the sulphates, may be inferred that of the seleniates; from the silicates that of the borates.

The applicability of this simple mode of decomposition to the explanation of a great variety of geological changes, is too evident to escape the attention of those conversant with that science. In a future paper I hope to be able to give a more complete account of some interesting facts which have been observed in connexion with this subject, and to verify, by experiment, many points which must at present be left to inference and conjecture. In fact, although the existence of this law of decomposition was ascertained in 1842, yet it has only been within a few months that I have been able to give much attention to its investigation, which must be my excuse for the imperfect and hurried manner in which it is now communicated.

London, August 3d, 1847.

ARTICLE XI.

On the Neutral Sulphate of the Oxide of Ethyle, and the products of its decomposition by water.
By Charles M. Wetherill, Doctor of Philosophy. Read July 21, 1848.

The neutral sulphate of the oxide of Ethyle has, as is well known, been sought after for years in vain; the reason of which is, that it resembles in some of its properties the so called heavy oil of wine, and therefore a closer examination of it has been neglected. This body, however, is always formed when anhydrous sulphuric acid and anhydrous ether (or absolute alcohol) are brought together in the cold. The most convenient method of preparing it, is as follows:—A matrass containing pure ether is surrounded with a mixture of snow and salt, and by means of a retort, the neck of which is drawn out and bent at a right angle, anhydrous sulphuric acid is distilled into it, slowly, from Nordhausen oil of vitriol. It is not necessary to immerse the neck of the retort in the ether, as the acid fumes being heavy, fall, and slowly combine with it. A syrup-like liquid remains in the matrass, which is agitated with an equal volume of ether, and four times the volume of water. When the liquid has become divided into two strata, the ether, which contains the neutral sulphate in solution, is separated by a funnel from the other stratum, which is strongly acid, and contains sulphuric, sulphurous, æthionic, and sulphovinic acids, or if the temperature has not been kept sufficiently low, carbon, and together with the above named acids, isœthionic and methionic acids, resulting from the decomposition of æthionic acid. The ether solution is next agitated with milk of lime, to remove sulphurous acid, (this removes at the same time part of the colouring matter;) washed with water, filtered, and the ether distilled off.

An oily liquid remains in the retort, which contains a trace of ether, and is slightly acid. This acid reaction, I believe, is due to the water which was dissolved in the ether, and which, aided by the heat used in distilling off the ether, decomposes the compound. For if a portion of the ether in a watch glass be suffered to evaporate spontaneously, an oil remains which is perfectly neutral, but which quickly becomes acid when warmed with

a few drops of water. The oil is transferred from the retort to a capsule, well washed with a small quantity of water, the last portions of which are carefully removed with strips of paper, and placed in the vacuum over sulphuric acid to dry.

It is an oily liquid of pungent taste, leaving a burning sensation in the throat; a smell of peppermint oil; leaves an oily stain on paper, which disappears entirely—sp. gr. 1.120; colourless when pure, but as obtained above it is usually coloured yellow. It distils with the greatest difficulty, on which account I could not obtain a sufficient quantity of the distilled oil to analyze perfectly. In order to distil it the retort must be low in the neck, and a stream of carbonic acid passed through the liquid. At 100° the vapours rise in the form of exceedingly small globules, visible to the naked eye. At 110°, 120°, they pass over, when the heat is raised to 130°, 140°, the liquid blackens, sulphurous acid and alcohol pass over, and if heated above this, sulphurous acid and olefiant gas. The distillate is perfectly colourless, heavier than water, neutral to test paper, two combinations, one of the raw oil, another of the distilled, agreed, but the substance had not yet been freed from water over sulphuric acid in vacuo. Chlorine, in the cold, does not decompose it, but is dissolved, communicating to it a green colour: on adding water, the oil is precipitated.

Sulphuretted hydrogen in the cold has no effect upon it. A solution of caustic potash, saturated with sulphuretted hydrogen, changes it to mercaptan, and sulphate of potash, unaccompanied by any other oil, as was proved by absorbing the mercaptan by oxide of mercury; the reaction appears to be $C_4H_5O, SO_3 + KSHS = C_4H_5S, HS + KO, SO_3$. The neutral sulphate is soluble in fuming nitric acid, from which it is precipitated by water. If caustic potash be now added till the liquid is nearly neutral, and the whole heated, hyponitrite of ethyle ($C_4H_5ONO_3$) is formed. This reaction was anticipated, as nitrate of potash, sulphuric acid, and alcohol, give the hyponitrite. Treated in the same way with HCl and KOHO, an oil distils over, heavier than water, having a smell of apples. With potassium, in the cold, it is unchanged; when warmed, the potassium takes fire, and among the other products, mercaptan is formed. With water, in the cold, after a lapse of time, when heated quickly, the oil disappears entirely, leaving a very acid solution. In vacuo it does not become green like the oil of wine described by Serullas.

The neutral sulphate of the oxide of ethyle, or, in short, sulphuric ether, has never been analyzed. Liebig made a single combustion of the oil, from sulphuric acid and alcohol, (which is probably identical with this.) The combustion was made merely for the purpose of trying his new method of organic analysis upon liquids slightly volatile. He did not make a sulphur determination. His results are as follows: 1.730 substance gave $CO_2 = 2.078$; $C = 33.485\%$ $HO = 0.940$ $H = 6.150\%$; which results agree with Serullas' formula for the heavy oil of wine. But at the same time he notices, without attempting to account for it, an essential difference from Serullas' oil, namely, that warmed with water, it did not give an oil free from sulphuric acid, but entirely disappeared.

The oil analyzed had a slight trace of acid, was freed from water by standing for several days over sulphuric acid in vacuo. The combustion was made in the ordinary way, the liquid being placed in a small closed tube, which was dropped into the combustion tube and the oil suffered to run out upon the sides. The results are as follows:

	Grammes.					
No. 1, with Cu O—	0.853,	gave $CO_2 = 0.960$;	$C = 30.692\%$*	and $HO = 0.481$;	$H = 6.307\%$.
No. 2, with Pb O Cr O_3	0.7905,	" " $= 0.8815$;	$C = 30.511\%$	" $= 0.450$;	$H = 6.325\%$.
No. 3, with Cu O & K O Cl O_5,	0.7530,	" " $= 0.849$;	$C = 30.713\%$	" $= 0.4251$;	$H = 6.268\%$.

The sulphuric acid was determined by heating the substance, till it disappeared, in a small retort containing caustic potash: to the neck of the retort was adapted a tube which was kept cool with wet paper, to prevent any of the oil escaping. The potash solution was transferred to a silver capsule, evaporated to dryness and strongly ignited;—redissolved in water, neutralized with hydrochloric acid, and the sulphuric acid precipitated by chloride of barium. These are the results of three experiments:

	Grammes.		
No. 1,	0.4895 gave Ba. O S $O_3 = 0.7372$;	$SO_3 = 51.559\%$.
No. 2,	0.4314 " " $= 0.6485$;	" $= 51\ 553\%$.
No. 3,	0.439 " " $= 0.6652$;	" $= 51.950\%$.

The mean of these six analyses compared with the calculation of the formula $C_4 H_5 O$ SO_3 is as follows:

		Calculated.		Experiment.
C_4	= 300	=	31.169	= 30.648
H_5	= 62.5	=	6.494	= 6.300
O	= 100	=	10.389	= 11.365
SO_3	= 500	=	51.948	= 51.687
	962.5		100.000	100.000

The heavy oil of wine, calculated, gives the following numbers:

		Calculated.
C_4	= 600	= 33.103
H_9	= 112.5	= 6.207
O	= 100	= 5.517
$2\,SO_2$	= 1000	= 55.173
	1812.5	100.000

The products of the decomposition of the neutral sulphate of the oxide of ethyle by water.

When water is added to sulphate of ether, the mixture heated, and from time to time shaken, the oil entirely disappears, leaving a very acid solution, which, when heated, gives off alcohol. If carbonate of barytes be added, until the liquid is saturated, three salts of barytes remain in solution. The filtered solution evaporated by a gentle heat, deposits a small quantity of crystals in the form of scales, before it is well concentrated. Spirits of wine is now added, which precipitates the remainder of this salt. Redissolved in water and precipitated by alcohol, it is obtained in fine white scales, which, when dried, have a pearly lustre. This salt has the characteristics of methionate of barytes, with which it corresponds in composition. 0.4025 of the salt, dried at 100°, ignited with $SO_3 HO$, gave

* Per centage.

0.271 $BaOSO_3$, which corresponds to 44.248%, BaO 0.544 burned with chromate of lead, gave $CO_2 = 0.0555$; C = 2.776% & HO = 0.095; H = 1.930%.

		Calculated.	Experiment.
BaO	—	44.033	44.248
C	—	3.517	2.776
H_2	—	1.722	1.930
O_4	—	—	—
S_2	—	—	—

The mother liquid of these crystals contains a salt soluble in alcohol, and which, purified by several crystallizations from spirits of wine, is obtained in fine needles. This salt is a mixture of sulphovinate with isœthionate of barytes. These two salts, when dried over sulphuric acid in vacuo, have exactly the same composition. The substance used for analysis contained a trace of alcohol, which was difficult to get rid of over sulphuric acid.

Ignited with sulphuric acid,

No. 1, 0.376 gave $BaOSO_3 = 0.219$; BaO = 38.271%.
No. 2, 0.413 " " = 0.258; " = 38.262%.

No. 1, 0.621 burned with chromate of lead, gave $CO_2 = 0.296$; C = 12.995% & HO = 0.1725; H = 3.075%.

		Calculated.	Found.
BaO	—	39.579	38.271
C_4	—	12.392	12.995
H_3	—	2.582	3.075
O	—	—	—
$2\,SO_3$	—	—	—

The salt analyzed was half sulphovinate, half isœthionate of barytes, as is shown by the following experiment. Sulphovinic acid, as is well known, is resolved at the boiling temperature into sulphuric acid and alcohol. Isœthionic acid is unchanged at the same temperature. 4.504 grammes of the salt, dissolved in water, and the barytes precipitated by sulphuric acid, gave $BaOSO_3 = 2.6005$ or BaO = 37.877%. The filtered solution boiled for several hours, saturated with carbonate of barytes, and the soluble isœthionate of barytes, precipitated by sulphuric acid, gave $BaOSO_3 = 1.105$, whence BaO = 16.776% of the original salt. But the acids before boiling saturated 37.877% of barytes, or nearly twice as much. The substance is therefore a mixture half sulphovinate, half isœthionate of barytes.

As the heavy oil of wine is not one of the products in the action of anhydrous sulphuric acid upon anhydrous ether, the explanation heretofore given of this reaction is necessarily erroneous. In the case of alcohol, the anhydrous acid was said first to form hydrated bisulphate of the oxide of ethyle, an excess of the acid decomposes the combined oxide of ethyle, depriving it of the elements of water, forming heavy oil of wine, and at the same time setting free the substance C_4H_4, which combining with $4\,SO_3$ & HO, form ethionic acid.

In the case of ether, the sulphuric acid was said to extract the elements of water, form-

ing heavy oil of wine; the hydrated acid unites with the ether to form bisulphate of the oxide of ethyle, and by the farther action of the anhydrous sulphuric acid, the same reaction takes place as in the case of alcohol.

Not the slightest trace, however, of heavy oil of wine is to be detected in the substance resulting from the action of anhydrous sulphuric acid upon ether and alcohol. Portions of this oil, obtained from ether and from alcohol, were decomposed by water, distilled, and the distillate suffered to stand several days over chloride of calcium; the experiment in the case of ether was repeated several times, but not the slightest indication of a light oil of wine was to be detected.

The following may possibly be the reaction which takes place. The anhydrous sulphuric acid partly unites with the oxide of ethyle to form the neutral compound, ($C_4 H_5 O S O_3$,) and partly decomposes the ether, taking from it water to form Regnault's compound ($1 S O_3 C_4 H_4$,) which unites with one equivalent of water to form æthionic acid, ($1 S O_3 C_4 H_5 O$.) Another portion of the sulphuric acid takes water and unites with ether to form sulphovinic acid.

In the case of alcohol; part of the sulphuric acid takes water from the alcohol to form hydrated acid, which, with another portion of alcohol, forms hydrated sulphovinic acid; the ether thus set free, partly combines with the sulphuric acid to the neutral sulphate; partly is decomposed, as in the case of ether, to æthionic acid.

The decomposition products of the heavy oil of wine, by water are sulphovinic acid, and a carburetted hydrogen, the so called light oil of wine. The decomposition products of sulphate of ether by water, are materially different, being isœthionic and sulphovinic acids, with methionic acid in small quantity, evidently an after product.

4 equivalents of the neutral sulphate, with 3 eq. water, give 1 eq. isœthionic acid, 1 eq. sulphovinic acid, and 2 eq. alcohol,—thus

$$4 (S O_3, C_4 H_5 O) + 4 H O = 2 S O_3, C_4 H_6 O_2 + 2 S O_3, C_4 H_5 O, H O + 2 (C_4 H_6 O, H O.)$$

According to Regnault, the corresponding neutral sulphate in the methylic series, is formed in a similar manner, by the action of anhydrous sulphuric acid upon methylic ether. I performed the above experiments while under the instruction of Professor Liebig, to whom I express my kindest thanks.

Dr. Charles M. Wetherill.

Giessen, April 15, 1848.

ARTICLE XII.

De Calculo Eclipsium Besseliano Commentatio. Auctore Dr. Gustavo Adolpho Jahn. Lipsiæ, 1848. *Read Feb. 2d*, 1849.

INTRODUCTIO.

Differentiam longitudinum locorum duorum in terra continenti sitorum ex observationibus astronomicis constituere, inter difficillima geographiæ mathematicæ problemata a viris rei gnaris, numeratur; qui quidem ad illud solvendum inter alias observationes potissimum eclipsium et verarum et apparentium usque ad nostros dies adhibuerunt. Negari quidem nequit, calculum differentiæ longitudinum haud difficulter componi ex veris eclipsibus observatis, hanc tamen non accurate exinde erui posse propter penumbram, inter omnes constat. Multo accuratior calculus ope apparentium eclipsium constitui potest, quum apparentes subtilius et politius observari quam veras natura rei patiatur: altera vero ex parte rationes, quæ exinde subducuntur, difficillimæ et nimis vagæ sunt, propterea quod parallaxes ibi occurrunt, cujus quantitatis formulas in summam, quæ fieri potest, simplicitatem redactas nondum videmus, licet multi summam huic rei navaverint operam. Ad hanc calculi difficultatem id accedit, quod, quantum Telluris forma a figura globi differat, ante nostra tempora non satis constabat. Quibus igitur rebus factum est, ut olim ad computandam differentiam, quæ sit inter geographicas duorum locorum longitudines, sæpius veræ adhiberentur, quam apparentes eclipses. Quæ autem Telluris compressio quum hoc sæculo in nostram rem accuratius definita esse videatur, item tubi validiores, calculandi methodi accuratius et in usum commodius compositæ, atque catalogi fixarum ephemeridesque ad altiorem sint adductæ perfectionem: observationes eclipsium apparentium præstantia superare observationes verarum, astronomi non fateri non potuerunt.

Ex ejusmodi autem eclipsium natura duplex, isque diversus rationum subducendarum modus oritur, cujus vetustiorem, qua semper sequaris singularum observationis partium seriem, propter vim parallaxium longinquitate laborare necesse est. Ad quam longinquitatem tollendam astronomis, qui his ultimis quinquaginta annis floruerunt, hoc curæ cordique erat, ut formula invenirent, quibus facillimo modo parallaxium vis exprimeretur.

Altera methodo adhibita id tantum agitur, ut, neglecta ordine singulorum momentorum

eclipsis apparentis, quæratur, quæ relatio tempore geocentricæ conjunctionis intercedat inter positiones veras atque semidiametros utriusque corporis cœlestis. Quarum vero ad rem quum nec computatione positionum apparentium utriusque corporis opus sit, nec quantitate compressionis Telluris accuratissime definita: rationes majori cum facilitate et celeritate subduci posse facile patet. Quare id miraberis, quod vestigia celleberrimi Lagrange, qui illius solutionis auctor est, nemo hucusque presserit, nec in usum differentiæ longitudinum eruendæ, ut saltem equidem comperi, hoc problema verterit. Egregiam enim Clausenii* solutionem, in qua de tempore minimæ distantiæ geometricæ, ut quantitate ignota, quæritur, ad nostram rem ægre poteris transferre. Besselius demum, Lagrangium secutus, elegantissimam et in usum calculi facillimam hujus problematis solutionem ante oculos posuit in Astronomische Nachrichten von Schumacher No. 151 u. 152, unter dem titel: Beiträge zur Theorie der Finsternisse und den Berechnungs-Methoden derselben. Quæ autem res in disputatione ab Besselio tractata geographiæ mathematicæ tantum utilitatis affert, ut non possimus non vehementer optare, ut formulæ ibi exquisitæ ad constituendam longitudinum differentiam adhibeantur: atqui illam rem ii tantum omni ex parte perspicere et intelligere possunt, qui in definienda longitudinum differentia multum et fere semper versantur. Quare operæ pretium nobis visum est, æquationes et formulas eadem qua Besselius serie accuratius in hocce libello explicare, annotationibus exornare atque exempla quædam in calculi usum communem, in quem Besselius nihil adjecit, addere.

PARS PRIMA.

De argumentatione analytica æquationum expressionum quæ a Besselio compositarum.

§ 1. Besselius, commemorata illa quam alio loco† docuerat, præ computatione occultationum fixarum, methodos disquirit, quæ in introductione a me jam expositæ sunt atque rationibus subducendis ex observatis solis et fixarum eclipsibus inserviunt. Quarum methodorum priorem, si respiciatur distantia longitudinum duorum observatoriorum, nondum accurate explicatam esse in secunda sectione docet, viam expediens, qua conjunctionis veræ ejusque correctæ tempus possit inveniri. Deinde ad alterum sese confert methodum, ita ut demonstret, methodum priorem ab ea superari non solum eo, quod positiones utriusque corporis cœlestis apparentes evitentur, sed eo etiam, quod faciliori computandi ratione multo celerius res perducatur ad finem. Quæ celeritas ita efficitur, ut, non tempus geocentricæ conjunctionis, sed ipsa observatorii longitudo geographica sumatur quantitas quæsita. Tertia porro in sectione ad solutionem perficiendam signa quantitatum constituit, quæ, etsi rei non satis convenire nobis videantur, hoc loco reservaturi et breviter descripturi sumus.

Litteræ α, δ, φ, π significent propioris corporis cœlestis argumenta vera, scilicet rectascensionem, declinationem, horizontalem semidiametrum et parallaxem æquatoralem: α',

* Astron. Nachrichten von Schumacher, No. 40.

† Astron. Nachr., No. 145. unter dem Titel: Ueber die Vorausberechnung der Sternbedeckungen. Von Herrn Professor Bessel.

δ, ϱ, apparentia earum argumenta; in remotioris corporis usum vero A, D, R, π vera argumenta, nimirum rectascensionem, declinationem, horizontalem semidiametrum et parallaxem æquatoralem; sed A', D', R' earum argumenta apparentia; littera μ porro significetur tempus observationis in gradus redactum, id est siderale; ϕ' geocentrica elevatio poli, atque r distantia, quæ inter centrum Telluris et observatoris positionem interposita est; denique demidiam Telluris axem majorem et minorem significent $\mathfrak{A}$, $\mathfrak{B}$; distantiam longitudinum ex oriente positive sumtam d, excentricitatis quadratum e^2, compressionem Telluris χ, distantiasque, quæ intercedunt inter corpus cœleste aut propius aut remotius atque Telluris centrum, $\mathfrak{d}$ et $\mathfrak{d}'$. Quibus enarratis, expedire nobis liceat viam, facillime inveniendi systema æquationum [r]:

$$\begin{aligned}
\triangle \cos\delta' \sin\alpha' &= \cos\delta \sin\alpha - r\cos\phi' \sin\pi \sin\mu \\
\triangle \cos\delta' \cos\alpha' &= \cos\delta \cos\alpha - r\cos\phi' \sin\pi \cos\mu \\
\triangle \sin\delta' &= \sin\delta - r\sin\phi' \sin\pi \\
\triangle' \cos D' \sin A' &= \cos D \sin A - r\cos\phi' \sin\pi \sin\mu \\
\triangle' \cos D' \cos A' &= \cos D \cos A - r\cos\phi' \sin\pi' \cos\mu \\
\triangle' \sin D' &= \sin D - r\sin\phi' \sin\pi'.
\end{aligned}$$

§ 2. Si igitur Telluris centrum A (Fig. 1) habetur origo coordinatarum linearum systematis rectiangularis, in quo Y A X æquatoris aream denotet, et A X lineam æquinoctiorum, M vero observatorium in Telluris superficie situm, M' corpus cœleste propius et M'' remotius; erit

$$\begin{array}{lll}
< \mathrm{Q\,A\,P} = \mu & < \mathrm{Q'\,A\,P'} = \alpha & < \mathrm{Q''\,A\,P''} = A \\
< \mathrm{M\,A\,P} = \phi' & < \mathrm{M'\,A\,P'} = \delta & < \mathrm{M''\,A\,P''} = D \\
\mathrm{M\,A} = r & \mathrm{M'\,A} = \mathfrak{d} & < \mathrm{M''\,A} = \mathfrak{d}'
\end{array}$$

ideoque, *si* x, y, z; x', y', z'; x'' y'' z'' sunt signa coordinatarum punctorum M, M' et M'':

$$\left.\begin{array}{lll}
x = r\cos\mu\cos\phi' & x' = \mathfrak{d}\cos\alpha\cos\delta & x'' = \mathfrak{d}'\cos A\cos D \\
y = r\sin\mu\cos\phi' & y' = \mathfrak{d}\sin\alpha\cos\delta & y'' = \mathfrak{d}'\sin A\cos D \\
z = r\sin\phi' & z' = \mathfrak{d}\sin\delta & z'' = \mathfrak{d}'\sin D
\end{array}\right\} (1.)$$

Fingas tibi M originem alius coordinatarum systematis ejusque rectiangularis, cujus coordinatæ punctorum M et M'', significentur litteris ξ', η', ζ'; ξ'', η'', ζ''; tunc habebis formulas æquationibus in (1.) analogas:

$$\left.\begin{array}{ll}
\xi' = \mathfrak{d}_1 \cos\alpha'\cos\delta' & \xi'' = \mathfrak{d}'_1 \cos A'\cos D' \\
\eta' = \mathfrak{d}_1 \sin\alpha'\cos\delta' & \eta'' = \mathfrak{d}'_1 \sin A'\cos D' \\
\zeta' = \mathfrak{d}_1 \sin\delta' & \zeta'' = \mathfrak{d}'_1 \sin D'
\end{array}\right\} (1.\ a.)$$

in quibus $\mathfrak{d}_1 = \mathrm{MM'}$ atque $\mathfrak{d}'_1 = \mathrm{MM''}$. Sed iterum

$$\left.\begin{array}{ll}
\xi' = x' - x & \xi'' = x'' - x \\
\eta' = y' - y & \eta'' = y'' - y \\
\zeta' = z' - z & \zeta'' = z'' - z
\end{array}\right\} (1.\ b.)$$

esse constat. Ex systematibus igitur (1. a.) et (1. b.) compositis derivatur:

$$\begin{aligned} \Delta_{,} \cos\alpha' \cos\delta' &= x' - x & \Delta_{,}' \cos A' \cos D' &= x'' - x \\ \Delta_{,} \sin\alpha' \cos\delta' &= y' - y & \Delta_{,}' \sin A' \cos D' &= y'' - y \\ \Delta_{,} \sin\delta' &= z' - z & \Delta_{,}' \sin D' &= z'' - z \end{aligned}$$

Si vero ex (1) valores quantitatum, quæ ex dextra parte signi æqualitatis in his æquationibus positæ sunt, substitueris, facile patet esse

$$\begin{aligned} \Delta_{,} \cos\alpha' \cos\delta' &= \Delta \cos\alpha \cos\delta - r \cos\mu \cos\phi' \\ \Delta_{,} \sin\alpha' \cos\delta' &= \Delta \sin\alpha \cos\delta - r \sin\mu \cos\phi' \\ \Delta_{,} \sin\delta' &= \Delta \sin\delta - r \sin\phi' \\ \Delta_{,}' \cos A' \cos D' &= \Delta' \cos A \cos D - r \cos\mu \cos\phi' \\ \Delta_{,}' \sin A' \cos D' &= \Delta' \sin A \cos D - r \sin\mu \cos\phi' \\ \Delta_{,}' \sin D' &= \Delta' \sin D - r \sin\phi'. \end{aligned}$$

Et si harum æquationem priores tres per $\vartheta_{,}$ posteriores vero per ϑ' diviseris, littera Δ pro $\frac{\Delta_{,}}{\vartheta_{,}}$ et Δ' pro $\frac{\Delta_{,}'}{\vartheta_{,}'}$ posita,* has invenies æquationes:

$$\left.\begin{aligned} \Delta \cos\alpha' \cos\delta' &= \cos\alpha \cos\delta - \frac{r}{\Delta} \cos\mu \cos\phi' \\ \Delta \sin\alpha' \cos\delta' &= \sin\alpha \cos\delta - \frac{r}{\Delta} \sin\mu \cos\phi' \\ \Delta \sin\delta' &= \sin\delta - \frac{r}{\Delta} \sin\phi' \\ \Delta' \cos A' \cos D' &= \cos A \cos D - \frac{r}{\Delta'} \cos\mu \cos\phi' \\ \Delta' \sin A' \cos D' &= \sin A \cos D - \frac{r}{\Delta'} \sin\mu \cos\phi' \\ \Delta' \sin D' &= \sin D - \frac{r}{\Delta'} \sin\varphi' \end{aligned}\right\} \text{(1. c.)}$$

Est porro $\frac{r}{\Delta} = \frac{r}{A} \cdot \frac{A}{\Delta}$, $\frac{r}{\Delta'} = \frac{r}{A} \cdot \frac{A}{\Delta'}$, atque $\frac{r}{A} = 1$, si $A = 1$, igitur $\frac{A}{\Delta} = \sin\pi$, $\frac{A}{\Delta'} = \sin\pi$, atque $\frac{r}{\Delta} = r \sin\pi$, $\frac{r}{\Delta'} = r \sin\pi'$.

Quibus valoribus quotientium $\frac{r}{\Delta}, \frac{r}{\Delta'}$ substitutis, systematis (1. c.) facies hæc est:

$$\left.\begin{aligned} \Delta \cos\delta' \sin\alpha' &= \cos\delta \sin\alpha - r \cos\phi' \sin\mu \sin\pi \\ \Delta \cos\delta' \cos\alpha' &= \cos\delta \cos\alpha - r \cos\phi' \cos\mu \sin\pi \\ \Delta \sin\delta' &= \sin\delta - r \sin\phi' \sin\pi \\ \Delta' \cos D' \sin A' &= \cos D \sin A - r \cos\phi' \sin\mu \sin\pi' \\ \Delta' \cos D' \cos A' &= \cos D \cos A - r \cos\phi' \cos\mu \sin\pi' \\ \Delta' \sin D' &= \sin D - r \sin\phi' \sin\pi' \end{aligned}\right\} (1)$$

quo in systemate insunt æquationes quæ sitæ.

§ 3. Brevitatis causa, quod ipse Besselius fecit, proponatur:

$$\begin{aligned} \cos\delta \sin\alpha - r \cos\phi' \sin\mu \sin\pi &= a \\ \cos\delta \cos\alpha - r \cos\phi' \cos\mu \sin\pi &= b \\ \sin\delta - r \sin\phi' \sin\pi &= c \end{aligned}$$

* Quare Besselii sententia non plane vera est, ex qua signa Δ, Δ' distantias, quæ sint inter utrumque corpus cœleste et terræ centrum denotent.

$$\begin{aligned}
\cos D \sin \mathcal{A} - r \cos \phi' \sin \mu \sin \pi' &= a' \\
\cos D \cos \mathcal{A} - r \cos \phi' \cos \mu \sin \pi' &= b' \\
\sin D \quad - r \sin \phi' \sin \pi' \quad &= c'
\end{aligned}$$

unde sequitur, ratione formularum (I) habita:

$$\begin{aligned}
\Delta \cos \delta' \sin \alpha' &= a & \Delta' \cos D' \sin \mathcal{A}' &= a' \\
\Delta \cos \delta' \cos \alpha' &= b & \Delta' \cos D' \cos \mathcal{A}' &= b' \\
\Delta \sin \delta' \quad &= c & \Delta' \sin D' \quad &= c'
\end{aligned}$$

igitur

$$\begin{aligned}
\Delta\Delta' \cos \delta' \sin \alpha' \cos D' \sin \mathcal{A}' &= aa' \\
\Delta\Delta' \cos \delta' \cos \alpha' \cos D' \cos \mathcal{A}' &= bb' \\
\Delta\Delta' \sin \delta' \sin D' \quad &= cc',
\end{aligned}$$

quibus ex tribus æquationibus additis petitur

$$\Delta\Delta' \cos \delta \cos D' (\cos \alpha' \cos \mathcal{A}' + \sin \alpha' \sin \mathcal{A}') + \Delta\Delta' \sin \delta' \sin D' = aa' + bb' + cc',$$

id est

$$\Delta\Delta' \left\{ \cos \delta' \cos D' \cos (\alpha' - \mathcal{A}') + \sin \delta' \sin D' \right\} = aa' + bb' + cc'. \quad \ldots \quad (2.)$$

Factor autem, cum factore $\Delta\Delta'$ conjunctus, æquiparat cosinum apparentis distantiæ quæ inter utriusque corporis centra est; si enim in triangulo M' P M'' (Fig. 2.) M' et M'' loca apparentia centrorum utriusque corporis cœlestis denotant, atque P significat polum æquatoris, primum invenies:

$$M' P = 90° - \delta', \; M'' P = 90° - D', \; < M' P M'' = \alpha' - \mathcal{A}';$$

exinde sequitur:

$$\cos M' M'' = \sin \delta' \sin D' + \cos \delta' \cos D' \cos (\alpha' - \mathcal{A}');$$

atque littera Σ pro M' M'' posita, æquatio ad (2.) hanc assumit formam:

$$\Delta\Delta' \cos \Sigma = aa' + bb' + cc' \quad \ldots \quad (2.\ a.)$$

Primo autem et ultimo defectus tempore quum sit $\Sigma = \varrho' \pm R'$, ita ut signum + ad externum pertineat tactum, signum — vero ad internum, sequitur

$$\Delta\Delta' \cos \Sigma = \Delta\Delta' \cos (\rho' \pm R')$$

$$\text{i. e. } \Delta\Delta' \cos \Sigma = \Delta\Delta' \cos \rho' \cos R' \mp \Delta\Delta' \sin \rho' \sin R' \quad \ldots \quad (2.\ a.^*)$$

Quum porro secundum (Fig. 1.)

$$\begin{aligned}
\mathfrak{z}_{,} : \mathfrak{z} &= \sin \rho : \sin \rho' \\
\mathfrak{z}'_{,} : \mathfrak{z}' &= \sin R : \sin R',
\end{aligned}$$

ergo

$$\frac{\mathfrak{z}_{,}}{\mathfrak{z}} \sin \rho' = \sin \rho \qquad \frac{\mathfrak{z}'_{,}}{\mathfrak{z}'} \sin R' = \sin R \quad \ldots \quad (2.\ b.).$$

Porro ex æquationibus (I.) derivatur

$$\Delta^2 = a^2 + b^2 + c^2 \qquad \Delta'^2 = a'^2 + b'^2 + c'^2 \quad \ldots \quad (2.\ c.)$$

Igitur loco $\sin \varrho'$, $\sin R'$ in (2. b.) si posueris cosinus, atque in æquationibus inde exortis

$$\Delta^2 \cos \rho'^2 = \Delta^2 - \sin \rho^2 \quad , \quad \Delta'^2 \cos R'^2 = \Delta'^2 - \sin R^2 \quad \ldots \quad (2.\ d.)$$

pro quantitatibus Δ^2, Δ'^2 ex dextra signi æquationis jacentibus substitueris earum valores ex (2. c.), invenies:

$$\left.\begin{aligned} \Delta \cos \varrho' &= \sqrt{a^2+b^2+c^2-\sin \rho^2} \\ \Delta' \cos R' &= \sqrt{a'^2+b'^2+c'^2-\sin R^2} \end{aligned}\right\} \ldots (2.\ c.)$$

atque si valores $\Delta \cos \varrho'$, $\Delta' \cos R'$ in (2. c.), et $\Delta \sin \varrho'$, $\Delta' \sin R'$ in (2. b.) definiti, in æquationem (2. a*.) substituuntur, formulam denique invenies:

$$\Delta\Delta' \cos \Sigma = \sqrt{(a^2+b^2+c^2-\sin \rho^2)}.\ \sqrt{(a'^2+b'^2+c'^2-\sin R^2)} \mp \sin \rho \sin R,$$

quam etiam Besselius proposuit.—Si porro hanc formæ $\Delta\Delta' \cos \Sigma$ valorem cum ejusdem formæ valore in (2. a.) invento conjunxeris, fit

$$\sqrt{(a^2+b^2+c^2-\sin \rho^2)}.\ \sqrt{(a'^2+b'^2+c'^2-\sin R^2)} \mp \sin \rho \sin R = aa'+bb'+cc',$$

unde, eliminatis, radicum signis, hanc æquationem habebis

$$\begin{aligned} &(aa'+bb'+cc')^2 \pm 2\,(aa'+bb'+cc') \sin \rho \sin R = \\ &(a'^2+b'^2+c'^2)\,(a^2+b^2+c^2) - (a'^2+b'^2+c'^2) \sin \rho^2 - (a^2+b^2+c^2) \sin R^2, \end{aligned}$$

cujus post facilem transformationem videbis formam hancce:

$$\begin{aligned} &(ab'-a'b)^2 + (ac'-a'c)^2 + (bc'-b'c)^2 = \\ &(a' \sin \rho \pm a \sin R)^2 + (b' \sin \rho \pm b \sin R)^2 + (c' \sin \rho \pm c \sin R)^2 \ldots (\text{II.}) \end{aligned}$$

Cujus quidem æquationis (II.) deductio, a Besselio (apud quem est [2.]) proposita, longe brevior est, quam cujus ratio facile possit intelligo. Profecto enim, ut unum tantummodo afferamus exemplum, cur ponat formulas tanquam notas

$$\begin{aligned} \Delta \sin \varrho' &= \sin \rho & \Delta \cos \varrho' &= \sqrt{a^2+b^2+c^2-\sin \rho^2} \\ \Delta' \sin R' &= \sin R & \Delta' \cos R' &= \sqrt{a'^2+b'^2+c'^2-\sin R^2}. \end{aligned}$$

Quibus rebus cognitis facile apparet, in æquatione (II.), quamvis observationis tempus t ipsum directe in ea non sit expressum, analysin eclipsium quam maxime universalem in esse atque ea de causa præferendam esse, quod, quum, argumentis apparentibus evitatis, non adhibeantur nisi vera, elementa calculi quæcunque ad Telluris centrum relata sunt. Quam æquationem, quum poli et originis angulorum ad polum jacentium positio ex arbitrio definiri possit, in innumeras alias æquationes posse transformari, Besselius quidem commemoravit, secutus autem est per totam suam disquisitionem æquationis (II.) transformationem:

$$\begin{aligned} e^2+f^2+g^2 = &(e \cos u + f \sin u \cos v - g \sin u \sin v)^2 \\ &+ (e \sin u - f \cos u \cos v + g \cos u \sin v)^2 \\ &+ (f \sin v + g \cos v)^2 \ldots\ldots\ldots\ldots (3.) \end{aligned}$$

cujus identicæ expressionis quantitates u, v angulorum argumenta, pro arbitrio accepta, significant.

§ 4. Æquationem illam, transformandam in posterum differens, ad casum, quem poteris in eclipsibus reperire, simplicissimum, in quarta sectione noster sese confert. Quæ summa simplicitas occurrit, si π' et R', igitur et $R=0$, sive, quod ad idem recurrit, si

fixæ occultatio in calculum vocanda est. Summam vero tantum hujus calculi, quæ his positis ex æquatione (II.) derivatur, quum Besselius commemoraverit, ratione eam inveniendi omissa cocta recoquere nobis non videmur transformationem accuratius proposituri. Posito igitur $\pi'=0$, $R=0$, æquatio (II.) hanc induit formam:

$$(a'^2+b'^2+c'^2)\sin\rho^2=(a\,b'-a'\,b)^2+(a\,c'-a'\,c)^2+(b\,c'-b'\,c)^2\ldots(3.\,a.)$$

porro formulæ § 3. incunte exhibitæ abeunt in

$$\begin{aligned} a&=\cos\delta\sin\alpha-r\cos\phi'\sin\mu\sin\pi & a'&=\cos D\sin\mathcal{A}\\ b&=\cos\delta\cos\alpha-r\cos\phi'\cos\mu\sin\pi & b'&=\cos D\cos\mathcal{A}\\ c&=\sin\delta-r\sin\phi'\sin\pi & c'&=\sin D \end{aligned}$$

ergo $a'^2+b'^2+c'^2=1$. Porro erat in (3.):

$$a\,b'-a'\,b=e,\ a\,c'-a'\,c=f,\ b\,c'-b'\,c=g\ldots(3.\,a^*.)$$

Igitur expressio (3. a.), argumentis D et $\mathcal{A}$ pro u et v substitutis, abit in

$$\begin{aligned}\sin\rho^2=&(e\cos D+f\sin D\cos\mathcal{A}-g\sin D\sin\mathcal{A})^2\\&+(e\sin D-f\cos D\cos\mathcal{A}+g\cos D\sin\mathcal{A})^2\\&+(f\sin\mathcal{A}+g\cos\mathcal{A})^2.\end{aligned}$$

Jam autem si pro a', b', c' valores modo inventos substitueris in (3. a.*) nempe:

$$\begin{aligned} e&=a\cos D\cos\mathcal{A}-b\cos D\sin\mathcal{A}\\ f&=a\sin D-c\cos D\sin\mathcal{A}\\ g&=b\sin D-c\cos D\cos\mathcal{A}, \end{aligned}$$

has videbis æquationes:

$$\begin{aligned} e\cos D+f\sin D\cos\mathcal{A}-g\sin D\sin\mathcal{A}&=\cos\delta\sin(\alpha-\mathcal{A})-r\cos\phi'\sin\pi\sin(\mu-\mathcal{A})\\ e\sin D-f\cos D\cos\mathcal{A}+g\cos D\sin\mathcal{A}&=0\end{aligned}$$

$$f\sin\mathcal{A}+g\cos\mathcal{A}=-\sin\delta\cos D+\cos\delta\sin D\cos(\alpha-\mathcal{A})+r\sin\pi\left\{\sin\phi'\cos D-\cos\phi'\sin D\cos(\mu-\mathcal{A})\right\};$$

et exinde formulam enucleatam:

$$\begin{aligned}\sin\rho^2=&\left\{\cos\delta\sin(\alpha-\mathcal{A})-r\cos\phi'\sin\pi\sin(\mu-\mathcal{A})\right\}^2\\&+\left\{\sin\delta\cos D-\cos\delta\sin D\cos(\alpha-\mathcal{A})-r\sin\pi\left[\sin\phi'\cos D-\cos\phi'\sin D\cos(\mu-\mathcal{A})\right]\right\}^2\end{aligned}$$

Sed ad diametrum ϱ eliminandum proportio $\mathcal{A}:\varrho=\sin\varrho:\sin\pi$ adhibetur, ex qua $\sin\varrho=\frac{\mathcal{A}}{\varrho}\times\sin\pi$ sequitur, i.e. si $\frac{\mathcal{A}}{\varrho}=k$ brevitatis causa ponitur, $\sin\varrho=k\sin\pi$. Si igitur $k\sin\pi$ pro $\sin\varrho$ substitueris, hancce habebis æquationem:

$$\begin{aligned}k^2=&\left\{\frac{\cos\delta\sin(\alpha-\mathcal{A})}{\sin\pi}-r\cos\phi'\sin(\mu-\mathcal{A})\right\}^2\\&+\left\{\frac{\sin\delta\cos D-\cos\delta\sin D\cos(\alpha-\mathcal{A})}{\sin\pi}-r\left[\sin\phi'\cos D-\cos\phi'\sin D\cos(\mu-\mathcal{A})\right]\right\}^2\ (\text{III.})\end{aligned}$$

quæ apud Besselium est [3.].

Annotatio. Ex Burckhardtii tabulis est

$$k=0.2725 \qquad \log k=9.4353665.$$

Si vero, brevitatis causa, hisce signis uteris

$$\left.\begin{array}{l} \dfrac{\cos\delta\,\sin(\alpha-\mathcal{A})}{\sin\pi}=P \\ \dfrac{\sin\delta\,\cos D-\cos\delta\,\sin D\,\cos(\alpha-\mathcal{A})}{\sin\pi}=Q \\ r\,\cos\phi'\,\sin(\mu-\mathcal{A})=u \\ r\,\sin\phi'\,\cos D-r\,\cos\phi'\,\sin D\,\cos(\mu-\mathcal{A})=v \end{array}\right\}\ (4.)$$

expressio [III.] in simplicissimam abit hanc formam:

$$k^2=(P-u)^2+(Q-v)^2\ \ldots\ (4.\ a.)$$

§ 5. Quantitates k, $P-u$, $Q-v$ aut augendo aut minuendo mutentur necesse est, quia ab elementis α, δ, π, e^2 et k pendent, quæ ipsa observationibus non omni ex parte respondent. Mutationes autem valorum P—u et Q—v, secundum Taylorii theorema, per partialia differentialium quota, ratione α, δ, π, et e^2 habita, atque per correctiones $\Delta\alpha$, $\Delta\delta$, $\Delta\pi$, et Δe^2 argumentorum α, δ, π et e^2 exprimi possunt.

Quodsi Z et Z' sunt mutationes valorum $P-u$ et $Q-v$, æquatio (4. a.) abit in hanc

$$(k+\Delta k)^2=(P-u+Z)^2+(Q-v+Z')^2\ \ldots\ (4.\ a.^*).$$

Sed quum correctiones $\Delta\alpha$, $\Delta\delta$, $\Delta\pi$ et Δe^2, propter summam recentium tabularum astronomicarum perfectionem, minimæ esse quantitatis per se pateat, earum producta et quadrata poteris missa facere, et habebis:

$$Z=a.\ \Delta\alpha+b.\ \Delta\delta+c.\ \Delta\pi+d.\ \Delta e^2$$
$$Z'=a'.\ \Delta\alpha+b'.\ \Delta\delta+c'.\ \Delta\pi+d'.\ \Delta e^2,$$

et hac de re pro (4. a.*)

$$\begin{aligned}(k+\Delta k)^2=&(P-u+a.\ \Delta\alpha+b.\ \Delta\delta+c.\ \Delta\pi+d.\ \Delta e^2)^2\\&+(Q-v+a'.\ \Delta\alpha+b'.\ \Delta\delta+c'.\ \Delta\pi+d'.\ \Delta e^2)^2\ \ldots\ (\text{IV.})\end{aligned}$$

qua in æquatione a, b, c, a', b', c' partialia differentialium quota, si respexeris argumenta α, δ, π et e^2, significare supra monitum est. Hæc æquatio Besselio est [4.]. Signa autem a, b, c, a', b', c' non satis commode ab auctore electa mihi videntur, propterea quod in usum aliorum argumentorum, quamvis ab hisce longe diversorum, supra sunt adhibita.

§ 6. His computatis et constitutis, id nunc agendum esse, ut ex æquatione (IV.) tempus primi meridiani, quod æquiparat tempus observationis, i. e. $t-d$, definiatur, sub finem quartæ sectionis dicit. Quam ob rem id in quinta sectione efficere studet, ut argumenta t et d in æquationem (IV.) introducat æquationemque in formam ad computandum faciliorem redigat. Quomodo hac in re progrediatur statim accuratius exposituri sumus.— Significetur per $T+T''$ primi meridiani tempus, ad quod quantitates α, δ, π referuntur; per p et q, tempore T, significentur valores P et Q; eorumque mutationes, intra tempus T'', per p' et q'; et denique per P et Q valores P et Q, tempore $T+T''$; his positis sequitur:

$$P=p+p'.\ T''\qquad,\qquad Q=q+q'.\ T''\ \ldots\ (5.).$$

Si pro correctionibus $\Delta\alpha$, $\Delta\delta$, $\Delta\pi$ et Δe^2 substituuntur hæc duæ i et i', locum habeant hæ formulæ:

$$p'.\,i - q'.\,i' = Z \quad , \qquad q'.\,i + p'.\,i' = Z' \qquad (5.^*),$$

quarum pro posteriore Besselius hanc

$$q'.\,i + q'.\,i' = a'.\,\Delta a + b'.\,\Delta\delta + c'.\,\Delta\pi + d'.\,\Delta e^2$$

falsam habet. Ceterum quatuor correctiones i, i', i'' et i''' pro his duabus i et i' exspectaveris, si Δa, $\Delta\delta$, $\Delta\pi$ et Δe^2 eliminandæ sunt. Quum autem $\Delta\pi$ et Δe^2 fere semper sint minutissimæ quantitates, licitum est pro Z et Z' formas $p'.\,i - q'.\,i'$ et $q'.\,i + p'.\,i'$ ponere, id quod ad calculum numericum instituendum esse aptissimum, paulo post demonstraturi sumus.

Quibus igitur valoribus P, Q, Z et Z' in (5.) et (5.*) dictis si in æquatione (IV.) uteris formula oritur

$$(k + \Delta k)^2 = (p + p'.\,T'' - u + p'.\,i - q'.\,i')^2 + (q + q'.\,T'' - v + q'.\,i + p'.\,i')^2 \ldots (5.\text{ a.}),$$

quæ, si ponitur

$$\left.\begin{aligned} p - u &= m \sin M & p' &= n \sin N \\ q - v &= m \cos M & q' &= n \cos N \end{aligned}\right\} \ldots (5.\text{ b.})$$

abit in hanc æquationem

$$\begin{aligned}(k + \Delta k)^2 &= \{m \sin M + (T'' + i)\, n \sin N - i'.\, n \cos N\}^2 \\ &\quad + \{m \cos M + (T'' + i)\, n \cos N + i'.\, n \sin N\}^2 \\ &= m^2 + n^2\,(T'' + i)^2 + n^2\, i'^2 + 2\, m\, n\,(T'' + i) \cos (M - N) - 2\, m\, n\, i' \sin (M - N),\end{aligned}$$

id est

$$(k + \Delta k)^2 = \{m \cos (M - N) + n\,(T'' + i)\}^2 + \{m \sin (M - N) - n\, i'\}^2,$$

quæ etiam in Besselii dissertatione legitur. Exinde vero sequitur, quum Δk^2 et i'^2, propter minimam quantitatem, omiseris:

$$\begin{aligned}\pm \sqrt{\{k^2 + 2\, k.\,\Delta k - m^2 \sin (M - N)^2 + 2\, m\, n\, i' \sin (M - N)\}} &= m \cos (M - N), \\ &= n\,(T'' + i).\end{aligned}$$

Si ponitur

$$k = \frac{m \sin (M - N)}{\cos \psi} \ldots\ldots (5\text{ c.})$$

et radix ex duabus prioribus classibus extrahitur (duæ nimirum illæ classes sufficiunt), erit:

$$T'' = -\frac{m \cos (M - N \pm \psi)}{n \cos \psi} - i \pm \frac{i'}{\tan \psi} \mp \frac{\Delta k}{n \sin \psi)}$$

et, quum ψ propter $\cos \psi$ negativos quoque valores habere possit,

$$T'' = -\frac{m \cos (M - N \mp \psi)}{n \cos \psi} - i \pm \frac{i'}{\tan \psi} \mp \frac{\Delta k}{n \sin \psi}$$

Sed aptius est, inferiore signo sublato, regulam a Besselio traditam sequi. Existit igitur formula, quæ apud Besselium [5.] est:

$$T'' = -\frac{m \cos (M - N - \psi)}{n \cos \psi} - i - \frac{i'}{\tan \psi} - \frac{\Delta k}{n \sin \psi} \ldots\ldots (\text{V.})$$

Ex eo, quod initio hujus §. $T + T'' = t - d$ positum erat, sequitur $d = t - T - T''$. Si igitur substituitur valor T'' modo inventus, videbimus æquationem, ex qua summa deducitur,

$$d = t - T + \frac{m \cos (M - N - \psi)}{n \cos \psi} + i + \frac{i'}{\tan \psi} + \frac{\Delta k}{n \sin \psi} \ldots . \text{(VI.)}$$

et quæ apud nostrum [6.] est.

§ 7. In sexta, septima atque octava sectione Besselius plura commemoravit, quæ iis, qui solutione illa usuri sunt, respicienda quidem, sed plurimis intellectu difficiliora sunt. Itaque ea, quæ hac de re accuratius sunt dicenda, quemadmodum in introductione promisimus, in practica demum parte proferemus, atque sufficiet, nostræ rei deductionis tantummodo formularum adjicere, earum, quæ Besselio sunt [7.], [8.], [9.] et [10.].

§ 8. In sexta sectione hoc schema propositum est:

$T - 2^h$	$a_{,,}$	$b_{,,}$			
$T - 1^h$	$a_{,}$	$b_{,}$	$c_{,}$		
T^h	a	b'	c	$d_{,}$	e
$T + 1^h$	a'	b''	c'	d'	
$T + 2^h$	a''				

Jam, si ab $a_{,,}$ profectus fueris, formula interpolationis nota habetur.

$$y = a_{,,} + \frac{x}{1} b_{,,} + \frac{x(x-1)}{1.2} c_{,} + \frac{x(x-1)(x-2)}{1.2.3} d_{,} + \frac{x(x-1)(x-2)(x-3)}{1.2.3.4} e + \ldots .$$

Ex hac interpolationis formula ut aliam invenias, qua, si ex a exordiendum est, uti possis, nulla alia re opus erit, quam ut $2 + T'$ substituatur pro x; qua ex substitutione sequitur:

$$y = (a_{,,} + 2\, b_{,,} + c_{,}) + (b_{,,} + \tfrac{3}{2} c_{,} + \tfrac{1}{3} d_{,} - \tfrac{1}{12} e)\, T'$$
$$+ (\tfrac{1}{2} c_{,} + \tfrac{1}{2} d_{,} - \tfrac{1}{24} e)\, T'^2 + (\tfrac{1}{6} d_{,} + \tfrac{1}{12} e)\, T'^3 + \tfrac{1}{24} e.\, T'^4 + \ldots .$$

Illud autem schema idem est, quam sequens:

$a_{,,}$	$a_{,} - a_{,,}$	$a - 2\, a_{,} + a_{,,}$	$a' - 3\, a + 3\, a_{,} - a_{,,}$	$a'' - 4\, a' + 6\, a - 4\, a_{,} + a_{,,}$
$a_{,}$	$a - a_{,}$	$a' - 2\, a + a_{,}$	$a'' - 3\, a' + 3\, a - a_{,}$	
a	$a' - a$	$a'' - 2\, a' + a$		
a'	$a'' - a'$			
a''				

ex quo sequitur:

$b = \frac{1}{2}(a' - a_{,})$, quod $2\, b = b_{,} - b'$; $c = a' - 2\, a + a_{,}$

$d = \frac{1}{2}(a'' - a_{,,}) - (a' - a_{,}) = \frac{1}{2}(a'' - a_{,,}) - 2\, b_{,}$ quod $2\, d = d_{,} + d'$;

$e = a'' - 4\, a' + 6\, a - 4\, a_{,} + a_{,,}$.

Est igitur $a_{,,} + 2\, b_{,,} + c_{,} = a$; porro

$b_{,,} + \frac{3}{2} c_{,} + \frac{1}{3} d_{,} - \frac{1}{12} e = \frac{2}{3}(a' - a_{,}) - \frac{1}{12}(a'' - a_{,,}) = \frac{4}{3} b - \frac{1}{6} d - \frac{1}{3} b = b - \frac{1}{6} d$:

deinde $\frac{1}{2} c_{,} + \frac{1}{2} d_{,} - \frac{1}{24} e = \frac{1}{2}(a' - 2\, a + a_{,}) - \frac{1}{24} e = \frac{1}{2} c - \frac{1}{24} e$;

postea $\frac{1}{6} d_{,} + \frac{1}{12} c = \frac{1}{12}(a'' - a_{,,}) - \frac{1}{6}(a' - a_{,}) = \frac{1}{6} d_{,}$

et denique $\frac{1}{24} e = \frac{1}{24} e$;

qui ultimo loco inventus valor y in hanc formulam abit:

$$y = a + (b - \tfrac{1}{6} d)\, T' + (\tfrac{1}{2} c - \tfrac{1}{24} e)\, T'^3 + \tfrac{1}{6} d.\, T'^3 + \tfrac{1}{24} e.\, T'^4 + \ldots .$$

quæ ita scripta, ut a, b, c, d, e in eodem ponantur loco, quo a, T', T'^2, T'^3, T'^4, ... hæc fit:

$$y = a + T'.\, b + \tfrac{1}{2} T'^2.\, c + \tfrac{1}{6}(T'^3 - T')\, d + \tfrac{1}{24}(T'^4 - T'^2)\, e + \ldots . \text{ seu}$$

$$y = a + T'.b + \frac{T'^2}{2}.c + \frac{T'(T'^2-1)}{2.3}d + \frac{T'^2(T'^2-1)}{2.3.4}e + \ldots . \text{(VII.)}$$

quæ formula apud Besselium [7.] est.

§ 9. Si porro secundum § 6. pro expressionibus

$$P = p + p'.T', \qquad Q = q + q'.T'$$

universales posueris $y = a + t.T'$, habebis $t = \frac{y-a}{T'}$, unde sequitur, formula (VII.) adhibita, t, id est p seu $q =$

$$b + \frac{T'}{2}.c + \frac{T'^2-1}{2.3}.d + \frac{T'(T'^2-1)}{2.3.4}e + \ldots . \text{(VIII.)}$$

quæ quidem formula apud Besselium [8.] est. Simili modo invenies expressionem, quæ Besselio est [9.]

§ 10. Valores $p' = \frac{dP}{\delta t}$, $q' = \frac{\delta Q}{\delta t}$ esse veros, per se patet. Hos igitur valores ut invenias, P et Q in (4) § 4., ratione habita temporis t, differentiandi sunt, unde:

$$p' = \frac{\cos\delta\cos(\alpha-A)}{\sin\pi}.\frac{d\alpha}{dt} - \frac{\sin(\alpha-A)\sin\delta}{\sin\pi}.\frac{d\delta}{dt} - \frac{\cos\delta\sin(\alpha-A)}{\sin\pi}.\cot\pi.\frac{d\pi}{dt}$$

$$q' = \frac{\cos\delta\cos D}{\sin\pi}.\frac{d\delta}{dt} + \frac{\sin D\cos(\alpha-A)\sin\delta}{\sin\pi}.\frac{d\delta}{dt} + \frac{\cos\delta\sin D\sin(\alpha-A)}{\sin\pi}.\frac{d\delta}{dt} - \left\{\frac{\sin\delta\cos D - \cos\delta\sin D\cos(\alpha-A)}{\sin\pi}\right\}\cot\pi\frac{d\pi}{dt}$$

Ut porro p' et q' fiant secundæ circuli, omnia membra æquationum p' et q' definientium per radium $\omega = 206265$, qui ipse per secundas exprimitur, sunt dividenda; atque facile patet:

$$\text{(X.)}\begin{cases} p' = \frac{\cos\delta\cos(\alpha-A)}{\omega\sin\pi}.\frac{d\alpha}{dt} - \frac{\sin\delta\sin(\alpha-A)}{\omega\sin\pi}.\frac{d\delta}{dt} - \frac{p}{\omega\tan\pi}.\frac{d\pi}{dt} \\ q' = \frac{\cos\delta\sin D\sin(\alpha-A)}{\omega\sin\pi}.\frac{d\alpha}{dt} + \left\{\frac{\cos\delta\cos D + \sin\delta\sin D\cos(\alpha-A)}{\omega\sin\pi}\right\}.\frac{d\delta}{dt} - \frac{q}{\omega\tan\pi}.\frac{d\pi}{dt} \end{cases}$$

quibus in formulis $\frac{d\alpha}{dt}$, $\frac{d\delta}{dt}$ et $\frac{d\pi}{dt}$ mutationes argumentorum α, δ et π resp. in una hora significant; quæ quidem formulæ Besselio in sectione octava sunt [10.]

§ 11. Cardo nonæ sectionis in eo vertitur, ut correctiones $\Delta\alpha, \Delta\delta, \Delta\pi$ et Δc^2 pro i et i' in formulam (VI.) restituantur. Erat enim secundum (5*) § 6.

$$p'.i - q'.i' = a\Delta\alpha + b\Delta\delta + c\Delta\pi + d\Delta c^2$$
$$q'.i + p'.i' = a'\Delta\alpha + b'\Delta\delta + c'\Delta\pi + d'\Delta c^2,$$

ubi, secundum ea quæ ad § 5, ex. adnotavimus, coëfficientes correctionum $\Delta\alpha, \Delta\delta, \Delta\pi$ et Δc^2 sunt partialia differentialium quota quantitatum $P - u$ et $Q - v$, si respexeris α, δ, π et c^2; igitur

$$a = \frac{d\,P}{d\,\alpha},\ b = \frac{d\,P}{d\,\delta},\ c = \frac{d\,P}{d\,\pi},\ d = -\frac{d\,u}{d\,e^2},$$
$$a' = \frac{d\,Q}{d\,\alpha},\ b' = \frac{d\,Q}{d\,\delta},\ c' = \frac{d\,Q}{d\,\pi},\ d' = -\frac{d\,v}{d\,e^2}.$$

Hæ expressiones ex differentiationibus æquationum (4.) § 4. nascuntur sic:

$$a = \frac{\cos\delta\cos(\alpha - A)}{\sin\pi}, \qquad a' = \frac{\cos\delta\sin D\sin(\alpha - A)}{\sin\pi},$$
$$b = -\frac{\sin\delta\sin(\alpha - A)}{\sin\pi}, \qquad b' = \frac{\cos\delta\cos D + \sin\delta\sin D\cos(\alpha - A)}{\sin\pi},$$
$$c = -\frac{P}{\tan\pi}, \qquad c' = -\frac{Q}{\tan\pi},$$
$$d = -\frac{d\,u}{d\,e^2}, \qquad d' = -\frac{d\,v}{d\,e^2}.$$

Si parvas quantitates $\alpha - A$, $\delta - D$ neglexeris, ex quo vitium alicujus momenti plane non poterit oriri, propterea quod $\Delta\alpha$, $\Delta\delta$, $\Delta\pi$ et Δe^2 ipsæ sunt minimæ quantitates; hæ simplicissimæ expressiones fient:

$$a = \frac{\cos\delta}{\sin\pi},\ b = o,\ c = -\frac{P}{\tan\pi},\ d = -\frac{d\,u}{d\,e^2};$$
$$a' = o,\ b' = \frac{1}{\sin\pi},\ c' = -\frac{Q}{\tan\pi},\ d' = -\frac{d\,v}{d\,e^2}.$$

Quodsi hos valores pro $a, b, c; a', b', c'$, substitueris in æquationibus i et i' definientibus, quæ occurrunt §. nostra ineunt, et si pro p' et q' sumseris valoris ex (5. b.) § 6.: sequetur

$$n\sin N.\ i - n\cos N.\ i' = \frac{\cos\delta}{\sin\pi}.\ \Delta\alpha - P\cot\pi.\ \Delta\pi - \frac{d\,u}{d\,e^2}.\ \Delta e^2$$
$$n\cos N.\ i + n\sin N.\ i' = \frac{1}{\sin\pi}.\ \Delta\delta - Q\cot\pi.\ \Delta\pi - \frac{d\,v}{d\,e^2}.\ \Delta e^2.$$

Quarum æquationem si prior per $\sin N$ atque posterior per $\cos N$ multiplicata, et deinde illa ad hanc addita est: fiet

$$n.\ i = \frac{\cos\delta\sin N}{\sin\pi}.\ \Delta\alpha + \frac{\cos N}{\sin\pi}.\ \Delta\delta - (P\sin N + Q\cos N)\cot\pi.\ \Delta\pi$$
$$- \left(\frac{d\,u}{d\,e^2}.\ \sin N + \frac{d\,v}{d\,e^2}.\ \cos N\right)\Delta e^2.$$

Sin autem priorem per $\cos N$ multiplicatam a posteriore per $\sin N$ multiplicata subtraxeris, erit:

$$n.\ i' = -\frac{\cos\delta\cos N}{\sin\pi}.\ \Delta\alpha + \frac{\sin N}{\sin\pi}.\ \Delta\delta - (Q\sin N - P\cos N)\cot\pi.\ \Delta\pi$$
$$- \left(\frac{d\,u}{d\,e^2}.\ \sin N - \frac{d\,u}{d\,e^2}.\ \cos N\right)\Delta e^2.$$

In his æquationibus quantitates $\Delta\alpha$, $\Delta\delta$, $\Delta\pi$ per radii partes sunt expressæ, quæ, ut secundæ fiant, dividendæ sunt per ω, § 10, commemoratum. Unde fit:

$$i = \frac{s\cos\delta\sin N}{n\,\omega\sin\pi}.\ \Delta\alpha + \frac{s\cos N}{n\,\omega\sin\pi}.\ \Delta\delta - \frac{s\,(P\sin N + Q\cos N)}{n\,\omega\sin\pi}.\ \cos\pi.\ \Delta\pi$$
$$- \frac{s\left(\frac{d\,u}{d\,e^2}.\ \sin N + \frac{d\,v}{d\,e^2}.\ \cos N\right)}{n\,\omega\sin\pi}.\ \omega\sin\pi.\ \Delta e^2$$

$$i' = -\frac{s\cos\delta\cos N}{n\,\omega\sin\pi}.\Delta\alpha + \frac{s\sin N}{n\,\omega\sin\pi}.\Delta\delta - \frac{s\,(Q\sin N - P\cos N)}{n\,\omega\sin\pi}.\cos\pi.\Delta\pi$$
$$- \frac{s\left(\frac{d\,v}{d\,e^2}\sin N - \frac{d\,u}{d\,e^2}.\cos N\right)}{n\,\omega\sin\pi}.\omega\sin\pi.\Delta e^2.$$

Quid denotet hoc loco signum s, in practica parte infra docebimus. Si brevitatis causa $\frac{s}{\omega\, n\sin\pi} = h$ ponitur, formulæ existunt:

$$i = h\sin N\cos\delta.\Delta\alpha + h\cos N.\Delta\delta - h\cos\pi.\Delta\pi\,(P\sin N + Q\cos N)$$
$$- h\,\omega\sin\pi.\Delta e^2\left(\frac{d\,u}{d\,e^2}\sin N + \frac{d\,v}{d\,e^2}\cos N\right),$$
$$i' = -h\cos N\cos\delta.\Delta\alpha + h\sin N.\Delta\delta + h\cos\pi.\Delta\pi\,(P\cos N - Q\sin N)$$
$$+ h\,\omega\sin\pi.\Delta e^2\left(\frac{d\,u}{d\,e^2}\cos N - \frac{d\,v}{d\,e^2}\sin N\right);$$

quas etiam Besselius habet. Jam vero si i et $\frac{\sin\psi}{h}$. atque i' et $\frac{\cos\psi}{h}$ inter se multiplicantur, deinde adduntur, hæc expressio videbitur:

$$\left(i + \frac{i'}{\tan\psi}\right)\frac{\sin\psi}{h} = -\cos(N+\psi)\cos\delta.\Delta\alpha + \sin(N+\psi).\Delta\delta$$
$$+ \cos\pi\,\mathfrak{A}.\Delta\pi + \omega\sin\pi\,\mathfrak{B}.\Delta e^2 \ldots\ldots (6.)$$

in qua brevitatis causa posuimus

$$\left.\begin{aligned} P\cos(N+\psi) - Q\sin(N+\psi) &= \mathfrak{A} \\ \frac{d\,u}{d\,e^2}\cos(N+\psi) - \frac{d\,v}{d\,e^2}\sin(N+\psi) &= \mathfrak{B} \end{aligned}\right\} \ldots\ldots (6.\text{a.}).$$

§ 12. Expressiones $\mathfrak{A}$ et $\mathfrak{B}$ definientes etiam alia ratione possunt transformari. Nam secundum (5.) et (5. b.) erat $P = p + n\sin N.\,T'$, $Q = q + n\cos N.\,T'$, itaque

$$\mathfrak{A} = (p + n\sin N.\,T')\cos(N+\Psi) - (q + n\cos N.\,T')\sin(N+\psi)$$
$$= -(q\sin N - p\cos N)\cos\psi - (p\sin N + q\cos N + n\,T')\sin\psi.$$

Jam ponas

$$q\sin N - p\cos N = x\,,\; n\,\tau = n\,T - s\,p\sin N - s\,q\cos N;$$

porro positumerat

$$s\,T' = t - d - T,\text{ unde } T = t - d - s\,T',$$

ergo

$$n\,\tau = n\,t - n\,d - s\,n\,T' - s\,p\sin N - s\,q\cos N,$$

et ex hac formula derivabitur

$$n\,T' = \frac{n}{s}(t - d - \tau) - p\sin N - q\cos N;$$

igitur

$$p\sin N + q\cos N + n\,T' = \frac{n}{s}(t - d - \tau,)$$

et demum

$$\mathfrak{A} = -\left\{x\cos\psi + \frac{n}{s}(t - d - \tau)\sin\psi\right\}. \ldots (7.)$$

Transformatio expressionis $\mathfrak{B}$ pendet ab inventione differentialium quotarum $\frac{d\,u}{d\,e^2}$, $\frac{d\,v}{d\,e^2}$, quæ ipsæ iterum a quantitatibus $r \sin \phi'$, $r \cos \phi'$ pendent. Quum $\frac{d\,u}{d\,e^2}$ et $\frac{d\,v}{d\,e^2}$, duplici modo definiri possint, etiam expressionem $\mathfrak{B}$ duplici modo poteris transformare: valor ϕ enim, qui inest in u et v, aut declinationem aut latitudinem quincti verticis denotat. Utrumque igitur accuratius inquiramus. Primum pro valoribus $r \sin \phi'$ et $r \cos \phi'$ expressiones sunt inveniendæ, in quibus e^2 et ϕ continentur. Æquationes

$$y^2 = B^2 - \frac{B^2}{A^2} x^2,\ x = r \cos \phi',\ y = r \sin \phi',\ \mathrm{t\,g}\ \phi' = \frac{B^2}{A^2} \tan \phi$$

adesse constat. Valores x et y si in primam substitueris æquationem, hæc existit æquatio:

$$r^2 \sin \phi'^2 = B^2 - \frac{B^2}{A^2} r^2 \cos \phi'^2,$$

ex qua, si diviseris per $\cos \phi'^2$ et $\sin \phi'^2$, sequitur

$$r^2 \tan \phi'^2 = \frac{B^2}{\cos \phi'^2} - \frac{B^2}{A^2} r^2, \qquad r^2 = \frac{B^2}{\sin \phi'^2} - \frac{B^2}{A^2} \cdot \frac{r^2}{\tan \phi'^2}.$$

Si deinde in his æquationibus pro $\tan \phi'$ posueris valorem supra inventum, et recordatus fueris $\frac{A^2 - B^2}{A^2} = e^2$ positum a nobis esse, post hæc omnia has invenies expressiones:

$$r \cos \phi' = \frac{\cos \phi}{\sqrt{1 - e^2 \sin \phi^2}}, \qquad r \sin \phi' = \frac{(1 - e^2) \sin \phi}{\sqrt{1 - e^2 \sin \phi^2}} \quad \ldots (7.\ \mathrm{a.}).$$

Ex utraque expressione per differentiationem habebis:

$$\frac{d \,.\, r \cos \phi}{d \,.\, e^2} = r \cos \phi' \,.\, \frac{\sin \phi^2}{2\,(1 - e^2 \sin \phi^2)}$$

$$\frac{d \,.\, r \sin \phi'}{d \,.\, e^2} = r \sin \phi' \,.\, \frac{\sin \phi^2}{2\,(1 - e^2 \sin \phi^2)} - \frac{\sin \phi}{\sqrt{1 - e^2 \sin \phi^2}};$$

ex posteriore vero æquatione in (7. a.) sequetur:

$$\frac{\sin \phi}{\sqrt{1 - e^2 \sin \phi^2}} = \frac{r \sin \phi'}{1 - e^2}$$

$$\text{itaque } \frac{d \,.\, r \cos \phi'}{d \,.\, e^2} = r \cos \phi' \,.\, \frac{r^2 \sin \phi'^2}{2\,(1 - e^2)^2},$$

$$\frac{d \,.\, r \sin \phi'}{d \,.\, e^2} = r \sin \phi' \,.\, \frac{r^2 \sin \phi'^2}{2\,(1 - e^2)^2} - \frac{r \sin \phi'}{1 - e^2}.$$

Si brevitatis causa $\frac{r \sin \phi'}{1 - e^2} = \beta$ ponitur, erit:

$$\frac{d \,.\, r \cos \phi}{d \,.\, e^2} = \tfrac{1}{2}\, \beta^2\, r \cos \phi',$$

$\frac{d \,.\, r \sin \phi'}{d \,.\, e^2} = \tfrac{1}{2}\, \beta^2\, r \sin \phi' - \beta$; ut in Besselii dissertatione.

Secundum autem § 4 (4.) est

$$u = r \cos \phi' \sin (\mu - A),\ v = r \sin \phi' \cos D - r \cos \phi' \sin D \cos (\mu - A),$$

ergo

$$\frac{d\,u}{d\,e^2} = \left(\frac{d \,.\, r \cos \phi'}{d \,.\, e^2} \right) \sin (\mu - A) = \tfrac{1}{2}\, \beta^2\, r \cos \phi' \sin (\mu - A),$$

id est

$$\frac{d\,u}{d\,e^2} = \tfrac{1}{2}\,\beta^2.\,u;$$

atque

$$\frac{d\,v}{d\,e^2} = \left(\frac{d\,.\,r\sin\phi'}{d\,.\,e^2}\right)\cos D - \left(\frac{d\,.\,r\cos\phi'}{d\,.\,e^2}\right)\sin D\cos(\mu - \mathcal{A})$$
$$= \tfrac{1}{2}\,\beta^2\,r\left\{\sin\phi'\cos D - \cos\phi'\sin D\cos(\mu-\mathcal{A})\right\} - \beta\cos D,$$

id est

$$\frac{d\,v}{d\,e^2} = \tfrac{1}{2}\,\beta^2.\,v - \beta\cos D$$

Quos valores modo interventos differentialium $\frac{d\,u}{d\,e^2}$ et $\frac{d\,v}{d\,e^2}$, si in expressionem quantitatis $\mathfrak{B}$ [§ 11. (6 a.)] posueris, hanc formulam habebis:

$$\mathfrak{B} = \tfrac{1}{2}\,\beta^2\,u\cos(N+\psi) - (\tfrac{1}{2}\,\beta^2\,v - \beta\cos D)\sin(N+\psi)$$
$$= \tfrac{1}{2}\,\beta^2\left\{u\cos(N+\psi) - v\sin(N+\psi)\right\} + \beta\cos D\sin(N+\psi) \ldots (7.\text{ b.})$$

Facile igitur intelligitur

$$u\cos(N+\psi) - v\sin(N+\psi) = \left\{P\cos(N+\psi) - Q\sin(N+\psi)\right\}$$
$$-\left\{(P-u)\cos(N+\psi) - (Q-v)\sin(N+\psi)\right\},$$

hoc est

$$= \mathfrak{A} - \left\{(P-u)\cos(N+\psi) - (Q-v)\sin(N+\psi)\right\}.$$

Sed ex (5.) § 6. derivabitur

$$P - u = p - u + p'.\,T', \qquad Q - v = q - v + q'.\,T';$$

et, si usurpaveris expressiones in (5. b.), habebis

$$P - u = m\sin M + n\sin N.\,T'$$
$$Q - v = m\cos M + n\cos N.\,T';$$

ergo

$$(P-u)\cos(N+\psi) - (Q-v)\sin(N+\psi) =$$
$$(m\sin M + n\sin N.\,T')\cos(N+\psi) - (m\cos M + n\cos N.\,T')\sin(N+\psi)$$
$$= m\left\{\sin M\cos(N+\psi) - \cos M\sin(N+\psi)\right\}$$
$$+ n\,T'\left\{\sin N\cos(N+\psi) - \cos N\sin(N+\psi)\right\}$$
$$= m\sin(M-N-\psi) - n\,T'.\sin\psi;$$

atque si pro T' valorem approximatum ex (V.) § 6. scilicet

$$T' = -\frac{m\cos(M-N-\psi)}{n\cos\psi}$$

posueris, $= m\sin(M-N-\psi) + \frac{m\cos(M-N-\psi)}{u\cos\psi}\,n\sin\psi = \frac{m\sin(M-N)}{\cos\psi}$, hoc est secundum (5. c.) § 6., $= k$; ergo $u\cos(N+\psi) - v\sin(N+\psi) = \mathfrak{A} - k$, atque sic, si hoc substitueris in (7. b.), $\mathfrak{B} = \frac{1}{2}\,\beta^2\,(\mathfrak{A} - k) + \beta\cos D\sin(N+\psi)$.

Si denique (id quod solum restat) pro $\mathfrak{A}$ ejus valor ex (7.) ponitur, erit:

$$\mathfrak{B} = \tfrac{1}{2}\,\beta^2\left\{-x\cos\psi - \frac{n}{s}(t-d-\tau)\sin\psi - k\right\} + \beta\cos D\sin(N+\psi)$$
$$= -\tfrac{1}{2}\,\beta^2\left\{x\cos\psi + \frac{n}{s}(t-d-\tau)\sin\psi + k\right\} + \beta\cos D\sin(N+\psi) \ldots (7.\text{ c.})$$

§ 13. Ex (6.) § 11. facillime deducitur:

$$i + \frac{i'}{\tan \psi} = -\frac{h \cos (N+\psi) \cos \delta}{\sin \psi} . \Delta \alpha + \frac{h \sin (N+\psi)}{\sin \psi} . \Delta \delta + \frac{h \cos \pi}{\sin \psi} . \mathfrak{A} . \Delta \pi + \frac{h \omega \sin \pi}{\sin \psi} . \mathfrak{B} . \Delta e^2$$

Hic summæ $i + \frac{i'}{\tan \psi}$ valor si ponitur in expressionem d, [§ 6. (VI.)] hæc existit æquatio:

$$d = t - T + \frac{m s \cos (M - N - \psi)}{n \cos \psi} - \frac{h \cos (N+\psi) \cos \delta}{\sin \psi} . \Delta \alpha + \frac{h \sin (N+\psi)}{\sin \psi} . \Delta \delta$$
$$+ \frac{h \cos \pi}{\sin \psi} . \mathfrak{A} . \Delta \pi + \frac{h \omega \sin \pi}{\sin \psi} . \mathfrak{B} . \Delta e^2 + \frac{s . \Delta k}{n \sin \psi} \ldots . \text{(7. d.)}$$

et, si pro $\mathfrak{A}$, $\mathfrak{B}$ eorum valores (7.), (7. c.) derivati substituuntur, erit

$$d = t - T + \frac{m s \cos (M - N - \psi)}{n \cos \psi} - \frac{h \cos (N+\psi) \cos \delta}{\sin \psi} . \Delta \alpha + \frac{h \sin (N+\psi)}{\sin \psi} . \Delta \delta$$
$$- \frac{h \cos \pi}{\sin \psi} . \Delta \pi \left\{ x \cos \psi + \frac{n}{s} (t - d - \tau) \sin \psi \right\} + \frac{\Delta k}{n \sin \psi}$$
$$- \frac{h \omega \sin \pi}{\sin \psi} . \Delta e^2 \left\{ \tfrac{1}{2} \beta^2 [x \cos \psi + \frac{n}{s} (t - d - \tau) \sin \psi + k] - \beta \cos D \sin (N + \psi) \right\};$$

vel, ut usui aptior sit,

$$d = t - T + \frac{m s \cos (M - N - \psi)}{n \cos \psi} - \frac{h \cos (N+\psi)}{\sin \psi} \cos \delta . \Delta \alpha$$
$$+ \frac{h \sin (N+\psi)}{\sin \psi} . \Delta \delta + h . \frac{1}{\sin \psi} . \omega \sin \pi . \Delta k$$
$$- h \cos \pi . \Delta \pi \left\{ \frac{x}{\tan \psi} + \frac{n}{s} (t - d - \tau) \right\}$$
$$- h \omega \sin \pi . \Delta e^2 \left\{ \tfrac{1}{2} \beta^2 \left[\frac{x}{\tan \psi} + \frac{n}{s} (t - d - \tau) + \frac{k}{\sin \psi} \right] - \frac{\beta V}{\sin \psi} \right\} \ldots . \text{(XI.)}$$

Hæc expressio Besselio in sectione (10.) est [11.]. Restat, ut moneamus, signum V, brevitatis causa positum, denotare cos D sin $(N + \psi)$, ad quod signum infra redeundum erit.

§ 14. Si pro rectascensionibus declinationibusque in calculo longitudines et latitudines adhibentur, cardo rei in eo versatur, ut latitudo ϕ' et longitudo μ puncti verticis ex rectascensione (μ) et declinatione (ϕ') data definiatur. Fingas tibi (Fig. 3.) P et E polos æquatoris et eclipticæ, Z punctum verticis, V intersectionem eclipticæ in æquatorem; erit $\angle E P Z = 90° + (\mu)$, arcus $P E = \varepsilon$ obliquitas eclipticæ; $V p = (\mu), V c = \mu, Z p = (\phi'), Z c = \phi'$. Jam in $\Delta V Z c$ est cos $V Z =$ cos μ cos ϕ', et in $\Delta V Z p$ est cos $V Z =$ cos (μ) cos (ϕ'); ergo cos μ cos $\phi' =$ cos (μ) cos (ϕ') . . . . (8.), porro in $\Delta P E Z$ est sin $\phi' =$ sin (ϕ') cos $\varepsilon -$ cos (ϕ') sin (μ) sin ε . . . (8. a.) Æquatio (8.) etiam ita scribi potest:

$$\cos \varphi' \sqrt{1 - \sin \mu^2} = \cos (\mu) \cos (\varphi'),$$

igitur

$$\cos \varphi'^2 - \cos \phi'^2 \sin \mu^2 = \cos (\mu)^2 \cos (\varphi')^2,$$

unde

$$\cos \varphi' \sin \mu = \sqrt{1 - \sin \varphi'^2 - \cos (\varphi')^2 \cos (\mu)^2},$$

Hac in formula igitur si pro sin ϕ'^2 valor ex (8. a.) ponitur, reductionibus quibusdam haud difficilibus adhibitis, hæc existit æquatio:

$$\cos\varphi' \sin\mu = \sin(\phi') \sin\varepsilon + \cos(\varphi') \sin(\mu) \cos\varepsilon \ldots . \text{ (8. b.)}$$

Nota.—In nona Besselianæ dissertationis sectione, p. 136, legendum est $\cos\phi' \sin\mu$ pro $\cos\phi' \sin\mu'$.

Erat autem secundum (4.) § 4.

$$u = r \cos\mathcal{A} \cos\varphi' \sin\mu - r \sin\mathcal{A} \cos\varphi' \cos\mu$$
$$v = r \cos D \sin\varphi' - r \sin D \cos\mathcal{A} \cos\varphi' \cos\mu - r \sin D \sin\mathcal{A} \cos\phi' \sin\mu ;$$

si igitur pro $\cos\phi' \sin\mu$, $\cos\phi' \cos\mu$ et $\sin\phi'$ valores modo deducti substituuntur erit:

$$u = r \sin(\varphi') \sin\varepsilon \cos\mathcal{A} + r \cos(\varphi') \left\{\cos\mathcal{A} \sin(\mu) \cos\varepsilon - \sin\mathcal{A} \cos(\mu)\right\}$$
$$v = r \sin(\varphi') \left\{\cos D \cos\varepsilon - \sin D \sin\varepsilon \sin\mathcal{A}\right\}$$
$$- r \cos(\varphi') \left\{\sin(\mu) \left[\cos D \sin\varepsilon + \sin D \cos\varepsilon \sin\mathcal{A}\right] + \cos(\mu) \sin D \cos\mathcal{A}\right\}.$$

Nota.—In Besselii dissertatione desideratur in ultimo membro æquationis v definientis signum $+$.

Secundum æquationis, quæ § 12. leguntur, habebis analogas:

$$\beta = \frac{r \sin(\varphi')}{1 - e^2}, \frac{d \cdot r \cos(\varphi')}{d \cdot e^2} = \tfrac{1}{2} \beta^2 r \cos(\varphi'),$$
$$\frac{d \cdot r \sin(\varphi')}{d \cdot e^2} = \tfrac{1}{2} \beta^2 r \sin(\varphi') - \beta ;$$

ergo

$$\frac{d u}{d e^2} = \sin\varepsilon \cos\mathcal{A} \left\{\tfrac{1}{2} \beta^2 r \sin(\varphi') - \beta\right\} + \left\{\cos\mathcal{A} \sin(\mu) \cos\varepsilon - \sin\mathcal{A} \cos(\mu)\right\} + \tfrac{1}{2} \beta^2 r \cos(\varphi')$$
$$= \tfrac{1}{2} \beta^2 \left\{r \sin(\varphi') \sin\varepsilon \cos\mathcal{A} + r \cos(\varphi') \left[\cos\mathcal{A} \sin(\mu) \cos\varepsilon - \sin\mathcal{A} \cos(\mu)\right]\right\} - \beta \sin\varepsilon \cos\mathcal{A},$$

hoc est

$$\frac{d u}{d e^2} = \tfrac{1}{2} \beta^2 u - \beta \sin\varepsilon \cos\mathcal{A} \ldots . \text{ (9.)}$$

atque

$$\frac{d v}{d e^2} = (\cos D \cos\varepsilon - \sin D \sin\varepsilon \sin\mathcal{A}) \left[\tfrac{1}{2} \beta^2 r \sin(\varphi') - \beta\right]$$
$$- \left\{\sin(\mu) \left[\cos D \sin\varepsilon + \sin D \cos\varepsilon \sin\mathcal{A}\right] + \cos(\mu) \sin D \cos\mathcal{A}\right\} \tfrac{1}{2} \beta^2 . r \cos(\varphi')$$
$$= \tfrac{1}{2} \beta^2 \left\{r \sin(\varphi') \left[\cos D \cos\varepsilon - \sin D \sin\varepsilon \sin\mathcal{A}\right]\right.$$
$$\left. - r \cos(\varphi') \left[(\cos D \sin\varepsilon + \sin D \cos\varepsilon \sin\mathcal{A}) \sin(\mu) + \sin D \cos\mathcal{A} \cos(\mu)\right]\right\}$$
$$- \beta (\cos D \cos\varepsilon - \sin D \sin\varepsilon \sin\mathcal{A}),$$

hoc est:

$$\frac{d v}{d e^2} = \tfrac{1}{2} \beta^2 v - \beta (\cos D \cos\varepsilon - \sin D \sin\varepsilon \sin\mathcal{A}) \ldots . \text{ (9. a.)}$$

Qui valores si posueris in æquationem (6. a.) § 11., erit

$$\mathfrak{V} = (\tfrac{1}{2} \beta^2 u - \beta \sin\varepsilon \cos\mathcal{A}) - \left\{\tfrac{1}{2} \beta^2 v - \beta (\cos D \cos\varepsilon - \sin D \sin\varepsilon \sin\mathcal{A})\right\} \sin(N + \psi)$$
$$= \tfrac{1}{2} \beta^2 \left\{u \cos(N + \psi) - v \sin(N + \psi)\right\} - \beta \sin\varepsilon \cos\mathcal{A} \cos(N + \psi)$$
$$+ \beta (\cos D \cos\varepsilon - \sin D \sin\varepsilon \sin\mathcal{A}) \sin(N + \psi);$$

id est:

$$\mathfrak{V} = \tfrac{1}{2} \beta^2 (\mathfrak{A} - k) - \beta \sin\varepsilon \cos\mathcal{A} \cos(N + \psi) + \beta (\cos D \cos\varepsilon - \sin D \sin\varepsilon \sin\mathcal{A}) \sin(N + \psi),$$

igitur etiam secundum (7.) § 12.

$$\mathfrak{A} = -\left\{[x\cos\psi + \frac{n}{s}(t-d-\tau)\sin\psi + k]\tfrac{1}{2}\beta^2 + \beta\sin\varepsilon\cos A\cos(N+\psi)\right.$$
$$\left. -\beta(\cos D\cos\varepsilon - \sin D\sin\varepsilon\sin A)\sin(N+\psi)\right\} \ldots . \text{(9. b.)}$$

Itaque si in (7. d.) § 13. pro $\mathfrak{A}$ et $\mathfrak{B}$ eorum valores ex (7.) § 12. et ex (9. b.) § 14. substitueris, redibit formula (XI.), si nimirum ibi ponitur:

$$V = (\cos D\cos\varepsilon - \sin D\sin\varepsilon\sin A)\sin(N+\psi) - \sin\varepsilon\cos A\cos(N+\psi) \ldots . \text{(9. c.)}$$

§ 15. Formula (XI.) etiam hac ratione scribi potest:

$$d = t - T + \frac{m\,s\cos(M-N-\psi)}{n\cos\psi} + h(\sin N\cos\delta\,.\,\Delta\alpha + \cos N\,.\,\Delta\delta)$$
$$+ \frac{h}{\tan\psi}(-\cos N\cos\delta\,.\,\Delta\alpha + \sin N\,.\,\Delta\delta - k\cos\pi\,.\,\Delta\pi)$$
$$+ \frac{h}{\sin\psi}(\omega\sin\pi\,.\,\Delta k) - \frac{h\,n}{s}(t-d-\tau)(\cos\pi\,.\,\Delta\pi)$$
$$-h\left\{\tfrac{1}{2}\beta^2\left[\frac{x}{\tan\psi} + \frac{n}{s}(t-d-\tau) + \frac{k}{\sin\psi}\right] - \frac{\beta V}{\sin\psi}\right\}(\omega\sin\pi\,.\,\Delta e^2) \ldots \text{(10.)}$$

Si igitur ponitur

$$\left.\begin{array}{l} +\sin N\cos\delta\,.\,\Delta\alpha + \cos N\,.\,\Delta\delta = \varepsilon \\ -\cos N\cos\delta\,.\,\Delta\alpha + \sin N\,.\,\Delta\delta - k\cos\pi\,.\,\Delta\pi = \zeta \\ \omega\sin\pi\,.\,\Delta k = \eta,\ \cos\pi\,.\,\Delta\pi = \theta,\ \omega\sin\pi\,.\,\Delta e^2 = i \end{array}\right\} \ldots . \text{(11.)}$$

expressiones (10) forma hæc erit:

$$d = t - T + \frac{m\,s\cos(M-N-\psi)}{n\cos\psi} + h\,\varepsilon + \frac{h}{\tan\psi}\zeta + \frac{h}{\sin\psi}\eta - h\,E\,.\,\theta - h\,F\,.\,i \ldots . \text{(XII.)},$$

ubi

$$E = \frac{n}{s}(t-d-\tau)$$
$$F = \left(\frac{x}{\tan\psi} + E + \frac{x}{\sin\psi}\right)\tfrac{1}{2}\beta^2 - \frac{V\beta}{\sin\psi} \ldots . \text{(n.)}$$

Expressio (XII.), apud Besselium [12.], nunc in calculo numerico formam commodiorem et ad perlustrandum faciliorem habet, quam quæ ei identica est (XI.).

§ 16. In duodecima sectione ad æquationem fundamentalem (II.) reversus, ejus formam usui aptissimam Besselius definire studet, id ponens utrique corpori cœlesti esse diametrum et parallaxin. Hanc nimirum dixit esse formam ad inveniendum difficiliorem, quam ubi de fixæ occultatione esset sermo. Quæ nunc dicturi sumus, ejus illustrabunt solvendi rationem.

§ 17. In æquatione (3.) secundum quadratum ita comparatum putes, ut possit in nihilum redigi, ita ut sit

$$e\sin u - f\cos u\cos v + g\cos u\sin v = 0 \ldots . \text{(13.)}$$

Quod autem fit, si cogites, expressionem

$$a\,b' - a'\,b)(c'\sin\pi - c\sin\pi') - (a\,c' - a'\,c)(b'\sin\pi - b\sin\pi') + (b\,c' - b'\,c)(a'\sin\pi - a\sin\pi') = 0$$

esse, itaque etiam

$$e(c'\sin\pi - c\sin\pi') - f(b'\sin\pi - b\sin\pi') + g(a'\sin\pi - a\sin\pi') = 0 \ldots \text{(13. a.)}$$

Æquatio (13.) non mutatur, si d et a pro u et v substitueris et deinde unum quodque membrum æquationis per novam quantitatem ignotam G multiplicaveris; quibus enim factis habebis

$$e\,G\sin d - f\,G\cos d\cos a + g\,G\cos d\sin a = 0 \ldots . \text{(13. b.)}$$

Igitur si comparaveris (13. b.) cum (13. a.) habebis tres hasce æquationes, quæ definiunt G, d et a:

$$\left.\begin{aligned} G\sin d &= c'\sin\pi - c\sin\pi' \\ G\cos d\cos a &= b'\sin\pi - b\sin\pi' \\ G\cos d\sin a &= a'\sin\pi - a\sin\pi' \end{aligned}\right\} \ldots \text{(13. c.)}$$

Quare mutata æquatio (3.)

$$e^2 + f^2 + g^2 = (e\cos u + f\sin u\cos v - g\sin u\sin v)^2 + (f\sin v + g\cos v)^2$$

hanc accipiet formam:

$$\begin{aligned} &(a\,b' - a'\,b)^2 + (a\,c' - a'\,c)^2 + (b\,c' - b'\,c)^2 = \\ &[(a\,b' - a'\,b)\cos d + (a\,c' - a'\,c)\sin d\cos a - (b\,c' - b'\,c)\sin d\sin a]^2 \\ &\quad + [(a\,c' - a'\,c)\sin a + (b\,c' - b'\,c)\cos a]^2 \ldots . \text{(13. d.)} \end{aligned}$$

§ 18. Si autem in (13. c.) pro a, b, c, a', b', c' earum valores ex sex prioribus æquationibus § 3. substitueris, accipies:

$$\left.\begin{aligned} G\sin d &= \sin\pi\sin D - \sin\pi'\sin\delta \\ G\cos d\cos a &= \sin\pi\cos D\cos\mathcal{A} - \sin\pi'\cos\delta\cos\alpha \\ G\cos d\sin a &= \sin\pi\cos D\sin\mathcal{A} - \sin\pi'\cos\delta\sin\alpha \end{aligned}\right\} \ldots . \text{(XIV.)}$$

quæ efficiunt systema illud Besselii [14.]. Porro si in (13. c.) pro a, b, c, a', b', c' earum valores ex sex posterioribus æquationibus § 3, substitueris, accipies:

$$\left.\begin{aligned} G\sin d &= \Delta'\sin\pi\sin D' - \Delta\sin\pi'\sin\delta' \\ G\cos d\cos a &= \Delta'\sin\pi\cos D'\cos\mathcal{A}' - \Delta\sin\pi'\cos\delta'\cos\alpha' \\ G\cos d\sin a &= \Delta'\sin\pi\cos D'\sin\mathcal{A}' - \Delta\sin\pi'\cos\delta'\sin\alpha' \end{aligned}\right\} \ldots . \text{(14.)}$$

Ultima in Besseliana dissertatione æquatio falsa est:

$$G\cos d\sin a = \Delta'\sin\pi\cos D'\cos\mathcal{A}' - \Delta\sin\pi'\cos\delta'\sin\alpha'.$$

Si in (XIV.) prima per secundam, et secunda per tertiam dividuntur, existunt expressiones:

$$\frac{\tan d}{\cos a} = \frac{\sin\pi\sin D - \sin\pi'\sin\delta}{\sin\pi\cos D\cos\mathcal{A} - \sin\pi'\cos\delta\cos\alpha} \ldots . \text{(14. a.)}$$

$$\frac{\cos a}{\sin a} = \frac{\sin\pi\cos D\cos\mathcal{A} - \sin\pi'\cos\delta\cos\alpha}{\sin\pi\cos D\sin\mathcal{A} - \sin\pi'\cos\delta\sin\alpha} \ldots . \text{(14. b.)}$$

ex quibus, eliminatis nominatoribus, sequuntur

$$\begin{aligned} &(\cos D\cos\mathcal{A}\tan d - \sin D\cos a)\sin\pi = (\cos\delta\cos\alpha\tan d - \sin\delta\cos a)\sin\pi' \\ &(\cos D\sin\mathcal{A}\cos a - \cos D\cos\mathcal{A}\sin a)\sin\pi = (\cos\delta\sin\alpha\cos a - \cos\delta\cos\alpha\sin a)\sin\pi'; \end{aligned}$$

et si æquationem primam per secundam diviseris, hæc æquatio existet:

$$\frac{\cos\mathcal{A}\tan d - \tan D\cos a}{\sin(\mathcal{A} - a)} = \frac{\cos\alpha\tan d - \tan\delta\cos a}{\sin(\alpha - a)}$$

ex qua, nominatoribus eliminatis, sequitur Besseliana æquatio conditionis [15]:

$$\tan\delta\sin(\mathcal{A} - a) - \tan D\sin(\alpha - a) + \tan d\sin(\alpha - \mathcal{A}) = 0 \ldots . \text{(XV.)}$$

§ 19. Porro, valoribus a, b, c, a', b', c' positis, invenitur

$$\begin{aligned} &a\,b' - a'\,b = \cos\delta\cos D\sin(\alpha - \mathcal{A}) \\ &- r\cos\phi'\sin\mu\,(\sin\pi\cos D\cos\mathcal{A} - \sin\pi'\cos\delta\cos\alpha) \\ &+ r\cos\phi'\cos\mu\,(\sin\pi\cos D\sin\mathcal{A} - \sin\pi'\cos\delta\sin\alpha) \\ &= \cos\delta\cos D\sin(\alpha - \mathcal{A}) - r\cos\phi'\,G\,.\cos d\sin(\mu - a); \end{aligned}$$

deinde

$$\begin{aligned} &a\,c' - a'\,c = \cos\delta\sin D\sin\alpha - r\cos\phi'\sin\mu\,(\sin\pi\sin D - \sin\pi'\sin\delta) \\ &- \cos D\sin\delta\sin\mathcal{A} + r\sin\phi'\,(\cos D\sin\mathcal{A}\sin\pi - \cos\delta\sin\alpha\sin\pi') \\ &= \cos\delta\sin D\sin\alpha - \cos D\sin\delta\sin\mathcal{A} - G\,(r\cos\phi'\sin d\sin\mu - r\sin\phi'\cos d\sin a); \end{aligned}$$

et denique

$$\begin{aligned} &b\,c' - b'\,c = \cos\delta\sin D\cos\alpha - r\cos\phi'\cos\mu\,(\sin\pi\sin D - \sin\pi'\sin\delta) \\ &- \cos D\sin\delta\cos\mathcal{A} + r\sin\phi'\,(\cos D\cos\mathcal{A}\sin\pi - \cos\delta\cos\alpha\sin\pi') \\ &= \cos\delta\sin D\cos\alpha - \cos D\sin\delta\cos\mathcal{A} - G\,(r\cos\phi'\sin d\cos\mu - r\sin\phi'\cos d\cos a). \end{aligned}$$

Est igitur:

$$\begin{aligned} &(a\,b' - a'\,b)\cos d + (a\,c' - a'\,c)\sin d\cos a - (b\,c' - b'\,c)\sin d\sin a = \\ &- \sin\delta\cos D\sin d\sin(\mathcal{A} - a) + \cos\delta\sin D\sin d\sin(\alpha - a) \\ &+ \cos\delta\cos D\cos d\sin(\alpha - \mathcal{A}) - G\,.\,r\cos\phi'\sin(\mu - a)\,.\,.\,.\,. \quad (15.) \end{aligned}$$

atque

$$\begin{aligned} &(a\,c' - a'\,c)\sin a + (b\,c' - b'\,c)\cos a = \cos\delta\sin D\cos(\alpha - a) \\ &- \sin\delta\cos D\cos(\mathcal{A} - a) + G\left\{r\sin\phi'\cos d - r\cos\phi'\sin d\cos(\mu - a)\right\}. \,.\,.\,. \quad (15.\,a.) \end{aligned}$$

Æquatio (XV.) vero, per $\cos\delta\cos D\sin d$ multiplicata, efficit

$$\begin{aligned} 0 = &\sin\delta\sin d\cos D\sin(\mathcal{A} - a) - \cos\delta\sin d\sin D\sin(\alpha - a) \\ &+ \frac{\sin d^2}{\cos d}\,.\,\cos\delta\cos D\sin(\alpha - \mathcal{A}). \,.\,. \quad (15.\,b.) \end{aligned}$$

Porro, si (15.) et (15. b.) adduntur, erit:

$$\begin{aligned} &(a\,b' - a'\,b)\cos d + (a\,c' - a'\,c)\sin d\cos a - (b\,c' - b'\,c)\sin d\sin a = \\ &\frac{\cos D}{\cos d}\,.\,\cos\delta\sin(\alpha - \mathcal{A}) - G\,.\,r\cos\phi'\sin(\mu - a), \end{aligned}$$

unde æquatio (13. d.):

$$\begin{aligned} &(a\,b' - a'\,b)^2 + (a\,c' - a'\,c)^2 + (b\,c' - b'\,c)^2 = \left\{\frac{\cos D}{\cos d}\,.\,\cos\delta\sin(\alpha - \mathcal{A}) - G\,.\,r\cos\phi'\sin(\mu - a)\right\}^2 \\ &+ \left[\cos\delta\sin D\cos(\alpha - a) - \sin\delta\cos D\cos(\mathcal{A} - a) + G\left\{r\sin\phi'\cos d - r\cos\phi'\sin d\cos(\mu - a)\right\}\right]^2. \,.\,. \quad (15.\,c.) \end{aligned}$$

Jam vero etiam erat secundum expressionem (II.)

$$\begin{aligned} &(a\,b' - a'\,b)^2 + (a\,c' - a'\,c)^2 + (b\,c' - b'\,c)^2 = (a'\sin\rho \pm a\sin R)^2 \\ &+ (b'\sin\rho \pm b\sin R)^2 + (c'\sin\rho \pm c\sin R)^2, \end{aligned}$$

igitur etiam

$$\begin{aligned} &(a'\sin\rho \pm a\sin R)^2 + (b'\sin\rho \pm b\sin R)^2 + (c'\sin\rho \pm c\sin R)^2 = \\ &\left\{\frac{\cos D}{\cos d}\,.\,\cos\delta\sin(\alpha - \mathcal{A}) - G\,.\,r\cos\phi'\sin(\mu - a)\right\}^2 + \\ &\left[\sin\delta\cos D\cos(\alpha - \mathcal{A}) - \cos\delta\sin D\cos(\alpha - a) - G\left\{r\sin\phi'\cos d - r\cos\phi'\sin d\cos(\mu - a)\right\}\right]^2 . \,.\,. \quad (15.\,d.) \end{aligned}$$

Quæ quidem expressio brevitatis causa hanc accipiat formam

$$W^2 = X^2 + Y^2.$$

Tum primum est

$$W'^2 = (a'^2 + b'^2 + c'^2) \sin \rho^2 \pm 2\,(aa' + bb' + cc') \sin \rho \sin R + (a^2 + b^2 + c^2) \sin R^2.$$

Deinde pro $a'^2 + b'^2 + c'^2$, $aa' + bb' + cc'$, $a^2 + b^2 + c^2$ earum valores ex (2. a.) et (2. c.) substituuntur, existit

$$W'^2 = \Delta'^2 \sin \rho^2 \pm 2\,\Delta\,\Delta' \cos \Sigma \sin \rho \sin R + \Delta^2 \sin R^2;$$

sed

$$\sin \rho = \Delta \sin \rho', \sin R = \Delta' \sin R', \cos \Sigma \cos (\rho' \pm R'),$$

igitur

$$\begin{aligned}
W'^2 &= \Delta^2 \Delta'^2 \{\sin \rho'^2 \pm 2 \cos (\rho' \pm R') \sin \rho' \sin R' + \sin R'^2\} \\
&= \Delta^2 \Delta'^2 \{(\sin \rho'^2 - \sin \rho'^2 \sin R'^2) + (\sin R'^2 - \sin R'^2 \sin \rho'^2) \pm 2 \sin \rho' \cos \rho' \sin R' \cos R'\} \\
&= \Delta^2 \Delta'^2 (\sin \rho'^2 \cos R'^2 \pm 2 \sin \rho' \cos R' \cos \rho' \sin R' + \cos \rho'^2 \sin R'^2) \\
&= \Delta^2 \Delta'^2 \sin (\rho \pm R')^2 \\
&= \Delta^2 \Delta'^2 \sin \Sigma^2, \text{ et exinde } \Delta^2 \Delta'^2 \sin \Sigma^2 = X^2 + Y^2.
\end{aligned}$$

Jam habetur

$$\begin{aligned}
\Delta \Delta' \sin \Sigma &= (\Delta \sin \rho') (\Delta' \cos R') \pm (\Delta' \sin R') (\Delta \cos \rho') \\
&= \sin \rho \sqrt{\Delta'^2 - \sin R^2} \pm \sin R \sqrt{\Delta^2 - \sin \rho^2};
\end{aligned}$$

sed secundum (2. c.):

$$\begin{aligned}
\Delta^2 &= a^2 + b^2 + c^2 = 1 - 2r \sin \pi \{\cos \delta \cos \phi' \cos (\alpha - \mu) + \sin \delta \sin \phi'\} + r^2 \sin \pi^2 \\
\Delta'^2 &= a'^2 + b'^2 + c'^2 = 1 - 2r \sin \pi' \{\cos D \cos \phi' \cos (\mathcal{A} - \mu) + \sin D \sin \phi'\} + r^2 \sin \pi'^2.
\end{aligned}$$

Positis igitur hisce expressionibus

$$\left.\begin{aligned}
\sin \phi' \sin \delta + \cos \phi' \cos \delta \cos (\alpha - \mu) &= \cos \gamma \\
\sin \phi' \sin D + \cos \phi' \cos D \cos (\mathcal{A} - \mu) &= \cos \gamma'
\end{aligned}\right\} \ldots . (15.\ c.)$$

erit

$$\begin{aligned}
\Delta^2 &= 1 - 2r \sin \pi \cos \gamma + r^2 \sin \pi^2 \\
\Delta'^2 &= 1 - 2r \sin \pi' \cos \gamma' + r^2 \sin \pi'^2
\end{aligned}$$

et exinde

$$\begin{aligned}
\Delta'^2 - \sin R^2 &= \cos R^2 - 2r \sin \pi' \cos \gamma' + r^2 \sin \pi'^2 \\
\Delta^2 - \sin \rho^2 &= \cos \rho^2 - 2r \sin \pi \cos \gamma + r^2 \sin \pi^2;
\end{aligned}$$

itaque, si brevitatis causa ponitur:

$$\left.\begin{aligned}
\sqrt{(\cos \rho^2 - 2r \sin \pi \cos \gamma + r^2 \sin \pi^2)} &= \lambda \\
\sqrt{(\cos R^2 - 2r \sin \pi' \cos \gamma' + r^2 \sin \pi'^2)} &= \lambda'
\end{aligned}\right\} \ldots . (15.\ f.)$$

erit

$$\begin{aligned}
\sqrt{\Delta'^2 - \sin R^2} &= \lambda' \\
\sqrt{\Delta^2 - \sin \rho^2} &= \lambda;
\end{aligned}$$

ergo

$$\Delta \Delta' \sin \Sigma = \lambda' \sin \rho \pm \lambda \sin R,$$

ergo

$$W'^2 = (\lambda' \sin \rho \pm \lambda \sin R)^2,$$

et exinde, quia $W'^2 = X^2 + Y^2$, si scilicet insuper etiam unum quodque membrum per G diviseris, quæsitam transformationem expressionis (II.) habebis:

$$\left(\frac{\lambda' \sin \rho \pm \lambda \sin R}{G}\right)^2 = \left\{\frac{\cos D}{\cos d}\cdot\frac{\cos \delta \sin (\alpha - A)}{G} - r \cos \phi' \sin (\mu - a)\right\}^2$$
$$+ \left\{\frac{\sin \delta \cos D \cos (A - a) - \cos \delta \sin D \cos (\alpha - a)}{G} - r\,[\sin \phi' \cos d - \cos \phi' \sin d \cos (\mu - a)]\right\}^2 \ldots \text{(XVI.)}$$

Expressio (XVI.) formam accepit $k^2 = (P - u)^2 + (Q - v)^2$, eandem, quæ occurrit in fixarum occultationibus, ita tamen, ut k^2 sit quantitas variabilis.

§ 20. Si utraque æquatio in (XIV), secunda scilicet et tertia, per se ipsam multiplicantur, deinde adduntur, hæc existit summa

$$G^2 \cdot \cos d^2 = \sin \pi^2 \cos D^2 - 2 \sin \pi \sin \pi' \cos D \cos \delta \cos (A - \alpha) + \sin \pi'^2 \cos \delta^2,$$

ad quam si prior in (XIV), etiam per se ipsam multiplicata, additur, fit:

$$G^2 = \sin \pi^2 - 2 \sin \pi \sin \pi' \{\cos \delta \cos D \cos (A - \alpha) + \sin \delta \sin D\} + \sin \pi'^2.$$

Sed factor cum $2 \sin \pi \sin \pi'$ conjunctus est analogus factori cum $\Delta\Delta'$ in (2.) conjuncto, ita tamen, ut quantitatibus quæ insunt in æquatione G^2 definiente non sint adscriptæ lineolæ; est igitur cosinus distantiæ veræ σ centrorum utriusque corporis celestis, quare etiam

$$G^2 = \sin \pi^2 - 2 \sin \pi \sin \pi' \cos \sigma + \sin \pi'^2,$$

ut apud Besselium legitur.

Si porro secunda et tertia æquatio systematis (XIV.) per $\sin A$ et $\cos A$ multiplicantur, et deinde subtrahuntur, existit:

$$G \cos d \sin (A - a) = \sin \pi' \cos \delta \sin (\alpha - A),$$

unde

$$\sin (A - a) = \frac{\sin \pi' \cos \delta \sin (\alpha - A)}{G \cos d},$$

igitur:

$$\tan (A - a) = \frac{\sin \pi' \cos \delta \sin (\alpha - A)}{G \cos \delta \cos (A - a)}.$$

Ex tertia vero æquatione systematis (XIV.) sequitur

$$G \cdot \cos d = \frac{\sin \pi \cos D \sin A - \sin \pi' \cos \delta \sin \alpha}{\sin a};$$

igitur, valore $G \cdot \cos d$ substituto,

$$\tan (A - a) = \frac{\sin \pi \cos \delta \sin (\alpha - A) \sin \alpha}{(\sin \pi \cos D \sin A - \sin \pi' \cos \delta \sin \alpha) \cos (A - a)}.$$

Si hoc loco $\cos (A - a)$ plene scribitur, deinde multiplicatio dicta fit, porro numeratores et nominatores per $\sin a$ dividuntur atque pro $\frac{\cos a}{\sin a}$ ejus valor ex (14. b.) substituitur, hæc denique existit expressio

$$\tan (A - a) = \frac{\sin \pi' \cos \delta \sin (\alpha - A)}{\sin \pi \cos D - \sin \pi' \cos \delta \cos (\alpha - A)} \ldots \text{(16.)}$$

at apud Besselium.

§ 21. Quum in solis eclipsibus quantitas σ semper sit parva, pro æquatione

$$G^2 = \sin\pi^2 - 2\sin\pi\sin\pi'\cos\sigma + \sin\pi'^2,$$

in antecedenti §. obvia, poni etiam potest:

$$G^2 = \sin\pi^2 - 2\sin\pi\sin\pi' + \sin\pi'^2,$$

id est

$$G = \sin\pi - \sin\pi' \ldots\ (16.\ a.)$$

Porro pro (16.) poni etiam potest

$$\mathcal{A} - a = \frac{(a - \mathcal{A})\sin\pi'}{\sin\pi - \sin\pi'},$$

igitur

$$a = \mathcal{A} - \frac{\sin\pi'}{\sin\pi - \sin\pi'}(a - \mathcal{A}),$$

seu tantum

$$a = \mathcal{A} - \frac{\sin\pi'}{\sin\pi}(a - \mathcal{A}) \ldots\ (16.\ b.)$$

Denique pro (14. a.) hoc solum poni potest:

$$d = \frac{D\sin\pi - \delta\sin\pi'}{\sin\pi - \sin\pi'} = \frac{D(\sin\pi - \sin\pi') - (\delta - D)\sin\pi'}{\sin\pi - \sin\pi'},$$

id est

$$d = D - \frac{\sin\pi'}{\sin\pi - \sin\pi'}(\delta - D)$$

seu tantum

$$d = D - \frac{\sin\pi'}{\sin\pi}(\delta - D) \ldots\ (16.\ c.)$$

PARS SECUNDA.

De usu æquationum expressionumque a Besselio inventarum.

Quum Besselius, quemadmodum sub finem introductionis atque § 7. commemoratum a nobis est, fere nihil monuerit, quomodo formulis inventis (P. I.) in calculo numerico uti possis; tentabimus, secundum formulas partis primæ docere, qua ratione ex observatis occultationibus et solis eclipsibus differentiæ longitudinum numerice derivari possint.

SECTIO PRIMA.

Quomodo ex observata fixæ occultatione longitudines geographicæ sint deducendæ.

§ 1. Besselius in septima et octava dissertationis sectione tria numericarum definitionum genera esse monuit, eorumque lineamenta descripsit. Quorum quidem generum primum ceteris duobus omni ex parte præferendum esse contendenti, omnibus tribus examinatis, jure meritoque assentior, quare non nisi in illo primo genere describendo acquiescemus.

§ 2. Si plures observationes unius occultationis fixæ calculandæ sunt, primum quodvis observationis tempus per media tempora solaria et sideralia exprimatur.* Deinde tempora media solaria ope longitudinum geographicarum, quamvisnondum satis accurate definitarum, in media tempora Berolinensia reducantur, atque ex eorum summa medium T derivetur, quod tantum ad quadrantes horæ usque exprimatur necesse est. Porro tempora sideralia per gradus expressa efficiunt μ. Postremo ex ephemeridibus Berolinensibus, ab Enckio editis, petantur argumenta α, δ et π, auxilio interpolationis formula (VII.) quam in hanc formam redegimus:

$$y = a + X.\, b + X'.\, c + X''.\, d + X'''.\, e + \ldots . \quad (1.),$$

ubi coëfficientes X, X', X'', X''', etc. ex tabula, quæ commentationi nostræ adjecta est, et in qua coëfficientes ad singulos horæ quadrantis pertinentes computati sunt, peti possunt. Commodius est, argumenta α, δ et π rectascensionem, declinationem et parallaxin lunæ; A et D vero fixæ rectascensionem et declinationem ab aberratione et nutatione affectam habere.

§ 3. Ex elevationibus polinotis ϕ observatoriorum secundum (7. a.) definiantur quantitates w et w' per formulas

$$w = \frac{\cos\phi}{\sqrt{1 - e^2 \sin\phi^2}} \quad (2.) \qquad w' = \frac{(1 - e^2)\sin\phi}{\sqrt{1 - e^2 \sin\phi^2}} \ldots . \quad (3.)$$

Nota.—Si Telluris compressio $\chi = \frac{1}{302}$ sumitur, est $\log e^2 = 7.8203066$, $\log (1 - e^2) = 9.9971191$.

Porro pro tribus temporibus $T - 1^h$, T^h, $T + 1^h$, quantitates P et Q calculentur, secundum (4.) partis primæ, per expressiones:

$$P = \frac{\cos\delta \sin(\alpha - A)}{\sin\pi} \ldots . \quad (4.)$$

$$C = \sin\delta \cos D \ldots . \quad (5.)$$

$$C' = \cos\delta \sin D \cos(\alpha - A) \ldots . \quad (6.)$$

$$Q = \frac{C - C'}{\sin\pi} \ldots . \quad (7.)$$

atque deinde, quod attinet ad utramque quantitatem P et Q formetur hoc schema:

$$\left.\begin{array}{l|llll} T - 1^h & a_{,} & & & \\ T^h & a & b_{,} & c & \frac{b_{,} + b'}{2} = b \\ T + 1^h & a' & b' & & \end{array}\right\} \ldots . \quad (8.),$$

quod vero attinet ad utramque quantitatem p' et q', hoc:

$$\begin{array}{l|l} T - 1^h & b - \frac{1}{2} c \\ T^h & b \qquad \ldots . \quad (9.). \\ T + 1^h & b + \frac{1}{2} c \end{array}$$

* Besselius commodius quidem esse censet (cf. dissert. sect. 6. pag. 129) temporibus observationum, per media, vera seu etiam sideralia tempora expressis ipsis in calculo uti, deinde formulam (6.) per numerum secundarum ejus temporum generis multiplicare, quod horam in calculo sumtam æquiparat, ut hac ratione differentiam meridianorum per secundas horæ expressam invenias; sed nemo non intelligit, si plura observationum tempora per diversa temporum genera expressa sint, etiam numerum secundarum, cui Besselius omnino signum s indidit, non semper eundem esse posse, ideoque, si respiciatur valor variabilis s, vitia comitti posse, qua propter computationes ipsas irritas fieri necesse sit.

Denique definiantur quantitates T' per æquationem $T'=t-T-d$, quæ quidem quantitates per horas earumque partes decimales expressæ inveniuntur, atque valores quantitatum, p' et q', quæ attinent ad tempora $T+T'$ ope schematis (9.) per interpolationem quærantur.

§ 4. Nunc demum calculus ipse incipit, qui per se spectatus summa est simplicitate et facilitate. Nam secundum (4.) (5. b.) et (5. c.) quantitates M, $\log m$, N, $\log n$ et ψ invenies per æquationes

$$u = w \sin(\mu - A) \quad \ldots\ (8^*.)$$
$$v = w' \cos D - w \sin D \cos(\mu - A) \quad \ldots\ (9^*.)$$
$$m \sin M = p - u \quad \ldots\ (10.)$$
$$m \cos M = q - v \quad \ldots\ (11.)$$
$$n \sin N = p' \quad \ldots\ (12.)$$
$$n \cos N = q' \quad \ldots\ (13.)$$
$$\cos\psi = \frac{m \sin(M-N)}{k} \quad \ldots\ (14.)$$
$$h = \frac{s}{n\,\omega \sin\pi} \quad \ldots\ (15.).$$

ubi p et q significant valores quantitatum P et Q tempore T, ideoque quovis observatorio usurpari possunt. Hoc vero tenendum est, angulum ψ intra 0° et 180° sumendum esse, si observationes sint immersiones, si vero emersiones sint, intra 180° et 360°. Ultimo loco definiantur quantitates T'', quæ etiam per minutas horæ expressæ inveniuntur, per æquationem

$$T'' = \frac{m\,s \cos(M-N-\psi)}{n \cos\psi} \quad \ldots\ (16.),$$

ubi $s = 60'$, $\log s = 1.7781512$, et in (14.) $\log k = 9.4353665$. Jam si valorem $t-T$, non, ut supra, per horas earumque partes decimales, sed per horæ minutas earumque partes decimales expresseris, derivabuntur secundum (XII.) veræ d ex formula

$$d = t - T + T'' + h \cdot \varepsilon + h \cot\psi\zeta \quad \ldots\ (17.)$$

et habebis ad quantitates $\Delta\alpha$, $\Delta\delta$ definiendas secundum (11.) primæ partis æquationes:

$$+\sin N \cos\delta \cdot \Delta\alpha + \cos N \cdot \Delta\delta = \varepsilon \quad \ldots\ (18.)$$
$$-\cos N \cos\delta \cdot \Delta\alpha + \sin N \cdot \Delta\delta = \zeta \quad \ldots\ (19.)$$

Nota.—Minus aptum certe mihi videtur esse, æquationibus (17.), (18.) et (19.) uti, quam expressione sequente secundum (XI.):

$$d = t - T + T'' - T'''\cdot\Delta\alpha + T^{iv}\cdot\Delta\delta \quad \ldots\ (17.^*)$$

ubi

$$T''' = \frac{h \cos(N+\psi)\cos\delta}{\sin\psi} \quad \ldots\ (18.^*)$$

et

$$T^{iv} = \frac{h \sin(N+\psi)}{\sin\psi} \quad \ldots\ (19.^*)$$

SECTIO SECUNDA.

Quomodo ex observata solis eclipsi longitudines geographicæ sint deducendæ.

§ 5. Besselius in ultima dissertationis sectione solis eclipses fere secundum easdem regulas quam fixarum occultationes computandas esse docuit.

§ 6. Primum aggrediaris rem secundum eandem rationem, quam § 2. descripsimus. Deinde secundum (7. a.) definiantur quantitates $r \cos \phi$, $r \sin \phi'$ per formulas

$$r \cos \phi' = \frac{\cos \phi}{\sqrt{1 - e^2 \sin \phi^2}} \ldots . (2.^*)$$

$$r \sin \phi' = \frac{(1 - e^2) \sin \phi}{\sqrt{1 - e^2 \sin \phi^2}} \ldots . (3.^*);$$

porro habebis pro æquationibus (1.), (5.), (6.) et (7.) § 3. hujus partes expressiones P et Q definientes, secundum (XVI.)

$$P = \frac{\cos D \cos \delta \sin (\alpha - A)}{G \cos d} \ldots . (4.^*)$$

$$Q = \frac{\sin \delta \cos D \cos (A - a) - \cos \delta \sin D \cos (\alpha - a)}{G} \ldots . (5.^*)$$

ubi G, a et d {secundum (16. a.), (16. b.) et (16. c.) § 21.} per æquationes

$$G = \sin \pi - \sin \pi' \ldots . (20.)$$

$$a = A - \frac{\sin \pi'}{\sin \pi} (\alpha - A) \ldots . (21.)$$

$$d = D - \frac{\sin \pi'}{\sin \pi} (\delta - D) \ldots . (22.)$$

definiuntur. In plurimis solis eclipsibus formulæ approximatæ plane satisfacient:

$$P = \frac{\cos \delta \sin (\alpha - A)}{G} \ldots . (4.^{**})$$

$$Q = \frac{\sin (\delta - D)}{G} \ldots . (5.^{**})$$

quoniam valores quantitatum G, a et d dati non nisi approximati sunt.

§ 7. Quod attinet ad formulas (8.) usque ad (15.) § 3. et § 4. hujus partis (excepta quantitate k), secundum quas fixarum occultationes sunt computandæ, etiam in solis eclipsibus valent. Sed valores u et v non secundum (8*.) et (9*.), sed secundum (XVI) per æquationes

$$u = r \cos \phi' \sin (\mu - a) \ldots . (23.)$$

$$x = r \sin \phi' \cos d \ldots . (24.)$$

$$y = r \cos \phi' \sin d \cos (\mu - a) \ldots . (25.)$$

$$v = x - y \ldots . (26.)$$

definiendi sunt. Quantitas k, si solis eclipses fiunt, non constans, sed variabilis est, quemadmodum sub finem § 19. primæ partis monuimus, ea de causa, quod pendet ab observatorio et a complementibus altitudinum solis atque lunæ. Itaque secundum (15. e.) et

(15. f.) § 19. hac ratione definienda est. Primum computentur quantitates trigonometricæ $\cos\gamma$ et $\cos\gamma'$, per expressiones

$$\cos\gamma = \sin\phi' \sin\delta + \cos\phi' \cos\delta \cos(\mu - a) \ldots . (27.)$$
$$\cos\gamma' = \sin\phi' \sin D + \cos\phi' \cos D \cos(\mu - A) \ldots . (28.),$$

porro

$$\lambda = \sqrt{\cos\rho^2 - 2r \sin\pi \cos\gamma + \sin\pi^2} \ldots . (29.)$$
$$\lambda' = \sqrt{\cos R^2 - 2r \sin\pi' \cos\gamma' + \sin\pi'^2} \ldots . (30.),$$

denique

$$k = \frac{\lambda' \sin\rho \pm \lambda \sin R}{G} \ldots . (31.)$$

idque nonnisi positive.

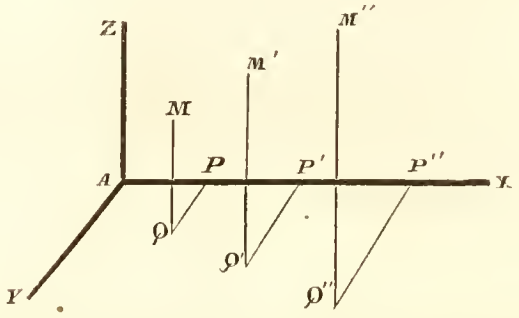
Quum vero $\cos\varrho^2$ et $\cos R^2$ prope $= 1$, atque $r^2 \sin\pi^2$ et $r^2 \sin\pi'^2$ quippe quæ fere semper sunt minimæ quantitates, salva calculi integritate negligi possint; pro (29.) et (30.) satisfacient expressiones approximatæ:

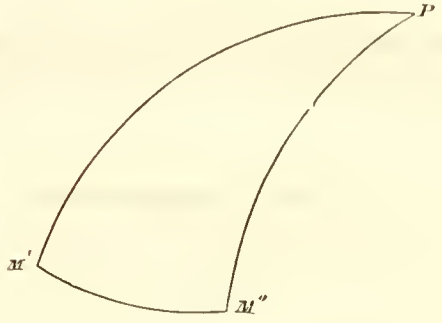
$$\lambda = \sqrt{1 - 2r \sin\pi \cos\gamma} \ldots . (29.^*)$$
$$\lambda' = \sqrt{1 - 2r \sin\pi' \cos\gamma'} \ldots . (30.^*)$$

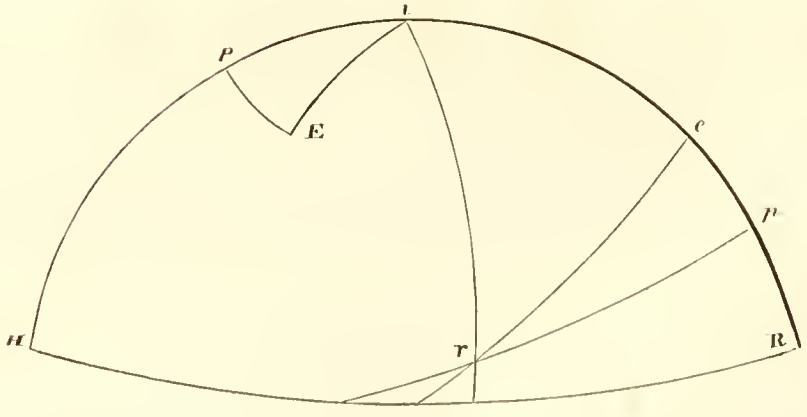
Calculus residuus, excepta quantitate k, eodem modo secundum formulas (16.) usque ad (19*.) fit, quem § 4, demonstravimus.

TABULA INTERPOLATIONIS.

$\pm x$	$\pm X$	$+X'$	$\mp X''$	$-X'''$
0^h	0.0000	0.0000	0.0000	0.000
1	0.0833	0.0035	0.0138	0.000
2	0.1667	0.0139	0.0270	0.001
3	0.2500	0.0313	0.0391	0.002
4	0.3333	0.0556	0.0494	0.004
5	0.4167	0.0868	0.0574	0.006
6	0.5000	0.1250	0.0625	0.008


Z
M''
M'
M
A
P
P'
P''
X
Q
Q'
Q''
Y


P
M'
M''


I
P
E
C
P'
H
T
R

ARTICLE XIII.

On the longitude of Washington, computed from the moon-culminations observed during the years 1839—1842 *inclusive, by Lieut. J. M. Gilliss. Read April 20th*, 1849.

The observations at Washington which form the basis of the subjoined computations, were made at the naval observatory by order of the honourable Secretary of the Navy, and were intended for the benefit of the exploring expedition. Having been printed at length by the U. S. Senate in 1846, and very generally distributed, it will scarcely be considered necessary to reprint any portion of them in this place.

It may, however, be proper to state:

The observatory was situated nearly twelve hundred feet N. 5° W. from the centre of the capitol-dome, and its approximate geographical position as follows:—Latitude by twelve meridian altitudes of north and south stars, observed with circles of ten inches diameter,

38° 53′ 33″ North.

Longitude from the solar eclipse of September, 1838; eight corresponding immersions, and thirteen corresponding emersions of stars with other observatories, and two vanishings of meteors observed also at Philadelphia,

$5^h\ 08^m\ 04^s.6$ West.

The observations were made with a five feet transit instrument, having an object glass of 3.75 inches aperture, constructed under the supervision of Mr. Hassler, for the Coast Survey, by Troughton, and by the former gentleman very kindly loaned to the Navy Department. It was very substantially mounted on granite piers. There was but one observer during the whole period, and each object was noted over five wires almost without exception; variations from the rule occurring only when the moon and stars followed each other too closely.

The differences of longitude have been calculated for the use of the U. S. Coast Survey, under the direction of Prof. A. D. Bache, by whose permission the principal data have been transcribed from the volumes which they fill. The formula adopted is that detailed

by Mr. S. C. Walker in Vol. V. Transactions Amer. Phil. Soc., *new series*, with a simple modification in the value of X as there given; that used in the computations, whose results follow, being the coefficient of t, whilst in the published paper referred to, it is the coefficient of $(t - 6^h\ 00^m\ 00^s)$.

The formula is thus explained by Mr. Walker:

"The computed increase of the right ascension of the moon's bright limb in passing from an eastern to a western meridian is obtained after Bessel's modification of Newton's formula for interpolation, from the moon-culminating series in the Nautical Almanac.

"The observed increase is derived from the series of corresponding observed culminations by Gauss' formula.

"The computed increase,

$$I' = b\,X + c\,X' + d\,X'' + e\,X'''$$

where

t = assumed longitude in time, west from Greenwich,
$X = [5.3645163]\,.\,t$
$X' = [5.06348]\,.\,(t - 12^h\ 00^m\ 00^s)\,X.$
$X'' = [4.8874]\,.\,(t - 6^h\ 00^m\ 00^s)\,.\,X'$
$X''' = [9.6498]\,.\,(t + 12^h\ 00^m\ 00^s).\,(t - 24^h\ 00^m\ 00^s)\,.\,X'$

b = first difference of the moon-culminating series.
c = second (mean)
d = third
e = fourth (mean).

Also for the computed increase I_o, let us call,

$\mathfrak{D}$ and $\mathfrak{D}'$ = the clock time of the culmination of the moon's bright limb at the eastern and western stations respectively.

$*$ and $*'$ = the same quantities for the star, corrected for rate in the intervals $(\mathfrak{D} - *)$ and $(\mathfrak{D}' - *')$ respectively.

μ and μ' = the number of wires at which the moon's limb was observed at the two stations respectively.

ν and ν' = the numbers for the stars.

$$\lambda = \frac{\mu\ \mu'}{\mu + \mu'},$$

$$\sigma = \frac{\nu\ \nu'}{\nu + \nu'}$$

[ ] Gauss' symbol for the aggregate of similar quantities enclosed.

$$n = \frac{3600}{I'} = 1 \div \text{seconds of increase of R. A. of the moon's bright limb.}$$

$$A = \mathfrak{D}' - \mathfrak{D}$$

$$B = \frac{[\sigma\,(* - *')]}{[\sigma]}$$

whence the

observed increase $I_o = A + B$.

Again, let,

$$e = {}^*I' - I_o$$

* When the eastern observatory is not Greenwich, the value of I' is the sum or difference of the two computed increases, according as they do or do not enclose its meridian in the shortest parallel between them.

h = the measure of precision = $\sqrt{\frac{\lambda \cdot [\sigma]}{nn\,(\lambda + [\sigma])}}$

$d_\circ$ and $d_\circ'$ = the assumed longitudes of the eastern and western stations from Greenwich + when east, — when west of that observatory.

d, and d' = the concluded values of the same.

$\Delta\, d_\circ = ne$ = single result for longitude of eastern from known western station.

$\Delta\, d_\circ' = -ne$ = single result for longitude of western from known eastern station.

ε = probable error of an observed transit over one wire.

And the final result,

$$\text{I} \ldots\ldots d = d_\circ + \frac{[hh \times ne]}{[hh]} \pm \frac{\varepsilon}{[hh]}$$

$$\text{II} \ldots\ldots d' = d_\circ' - \frac{[hh \times ne]}{[hh]} \pm \frac{\varepsilon}{[hh]}$$

The corresponding observations made at Copenhagen, Kremsmünster, Cracow and Wilna have also been computed, but the results indicate errors of such magnitude in their adopted longitudes, that they have not been incorporated herein. Edinburgh, Oxford, Cambridge and Hamburgh, on the other hand, having been connected with Greenwich by chronometric differences, are regarded as equally well known with that observatory, and every corresponding observation has been calculated and included howsoever discordant its results.

WASHINGTON AND EDINBURGH.

Moon's first limb.

YEAR AND DAY.	B	I	$I_\circ$	e	n	ne	$hh \times ne$	hh
	s	m s	m s	s		s	s	
1839. January 24,	+ ·242	12 45 ·162	12 45 ·703	— ·541	23 ·253	— 12 ·59	— 4 ·226	·336
" 26,	— ·053	12 58 ·817	12 58 ·791	+ ·023	22 ·651	+ 0 ·52	+ 0 ·191	·365
March 24,	+ ·213	10 57 ·753	10 58 ·248	— ·495	26 ·678	— 13 ·20	— 3 ·479	·263
" 25,	— ·175	10 07 ·925	10 08 ·353	— ·428	28 ·890	— 12 ·37	— 2 ·962	·239
April 21,	— ·130	10 28 ·410	10 28 ·275	+ ·135	27 ·939	+ 3 ·77	+ 0 ·805	·213
" 26,	— ·317	8 57 ·443	8 57 ·208	+ ·235	33 ·093	+ 7 ·78	+ 1 ·085	·139
" 27,	+ ·150	9 19 ·069	9 18 ·948	+ ·112	31 ·876	+ 3 ·57	+ 0 ·439	·123
May 22,	+ ·515	8 48 ·005	9 48 ·676	— ·671	33 ·498	— 22 ·48	— 3 ·338	·148
" 24,	— ·300	9 10 ·300	9 10 ·845	— ·455	32 ·327	— 14 ·71	— 1 ·759	·120
August 18,	— ·410	11 29 ·900	11 29 ·976	— ·076	25 ·841	— 1 ·96	— 0 ·367	·187
Septem. 20,	— ·054	11 08 ·691	11 08 ·595	+ ·099	26 ·439	+ 2 ·62	+ 0 ·595	·227
" 22,	— ·125	11 00 ·315	11 00 ·445	— ·130	26 ·875	— 3 ·49	— 0 ·825	·236
October 17,	+ ·005	10 58 ·215	10 58 ·615	— ·400	26 ·836	— 10 ·73	— 2 ·481	.231
" 19,	— ·285	10 49 ·305	10 49 ·693	— ·388	27 ·316	— 10 ·60	— 2 ·258	·213
" 20,	— ·160	11 06 ·590	11 07 ·262	— ·672	26 ·671	— 17 ·92	— 3 ·149	·176
Novem. 16,	+ ·129	10 36 ·259	10 35 ·825	+ ·424	27 ·950	+ 11 ·85	+ 2 ·816	·238
" 17,	+ ·140	11 05 ·680	11 06 ·098	— ·418	26 ·778	— 11 ·19	— 2 ·602	·232
" 19,	— ·036	12 55 ·514	12 55 ·879	— ·365	23 ·057	— 8 ·42	— 3 ·123	·371
1840. January 12,	+ ·110	11 15 ·310	11 15 ·958	— ·648	26 ·436	— 16 ·31	— 3 ·896	·238
" 15,	— ·140	14 01 ·550	14 01 ·996	— ·446	21 ·145	— 9 ·43	— 2 ·635	·280
" 16,	— ·247	14 12 ·833	14 13 ·954	—1·121	20 ·732	— 23 ·24	—10 ·815	·465

YEAR AND DAY.	B	I	I_0	e	n	ne	$hh \times ne$	hh
	s	m s	m s	s		s	s	
1840. February 11,	—·050	13 25 ·220	13 25 ·703	— ·483	22 ·117	— 10 ·67	— 1· 987	·186
" 12,	—·004	13 47 ·006	13 47 ·681	— ·675	21 ·434	— 14 ·47	— 5· 621	·389
March 11,	—·125	13 29 ·725	13 29 ·997	— ·272	21 ·807	— 5 ·93	— 2· 078	·350
" 13,	—·067	11 56 ·793	11 57 ·472	— ·679	24 ·487	— 16 ·63	— 4. 708	·283
" 17,	—·042	9 28 ·808	9 29 ·180	— ·372	31 ·069	— 11 ·56	— 2. 338	·202
April 10,	—·030	11 12 ·550	11 12 ·945	— ·395	26 ·090	— 10 ·31	— 1· 892	·184
" 13,	—·010	9 25 ·590	9 25 ·575	+ ·015	31 ·250	+ 0 ·47	+ 0· 031	·066
" 15,	+ ·030	9 25 ·690	9 26 ·185	— ·495	31 ·375	— 15 ·53	— 2· 958	·190
June 7,	± ·000	9 24 ·780	9 25 ·043	— ·263	31 ·273	— 8 ·22	— 1· 402	·170
" 13,	—·024	11 11 ·756	11 11 ·732	+ ·024	26 ·472	+ 0 ·64	+ 0· 144	·227
July 10,	—·100	11 04 ·960	11 04 ·702	+ ·258	27 ·513	+ 7 ·10	+ 0· 853	·120
August 6,	—·086	10 57 ·274	10 57 ·495	— ·221	27 ·066	— 5 ·98	— 1· 334	·223
" 11,	+ ·014	10 39 ·674	10 39 ·738	— ·064	27 ·579	— 1 ·77	— 0· 453	·257
Septem. 7,	+ ·006	10 48 ·166	10 48 ·645	— ·479	27 ·217	— 13 ·04	— 3· 666	·281
" 10,	—·280	10 01 ·100	10 01 ·198	— ·098	29 ·460	— 2 ·89	— 0· 554	·192
October 3,	—·125	11 08 ·815	11 09 ·199	— ·384	26 ·423	— 10 ·15	— 2· 421	·239
" 6,	+ ·650	10 10 ·880	10 10 ·625	+ ·255	28 ·943	+ 7 ·38	+ 1· 036	·140
" 7,	—·047	10 01 ·423	10 01 ·627	— ·204	29 ·412	— 6 ·00	— 1· 020	·170
" 8,	—·017	10 04 ·223	10 04 ·497	— ·274	29 ·368	— 8 ·05	— 1· 866	·232
" 9,	—·125	10 21 ·075	10 21 ·652	— ·577	28 ·632	— 14 ·89	— 3· 028	·203
Novem. 4,	+ ·060	9 50 ·060	9 49 ·930	+ ·130	30 ·068	+ 3 ·91	+ 0· 540	·138
" 5,	+ ·058	10 02 ·978	10 03 ·129	— ·151	29 ·496	— 4 ·45	— 1· 024	·230
" 6,	+ ·170	10 32 ·790	10 32 ·890	— ·100	28 ·184	— 2 ·82	— 0· 065	·236
December 1,	—·028	9 33 ·002	9 33 ·027	— ·025	30 ·905	— 0 ·77	— 0· 169	·218
" 2,	—·022	9 37 ·358	9 37 ·627	— ·269	30 ·749	— 8 ·27	— 2· 187	·264
1841. January 2,	± ·000	11 44 ·980	11 45 ·577	— ·597	25 ·391	— 15 ·15	— 2· 514	·166
" 4,	+ ·087	14 04 ·877	14 05 ·275	— ·398	21 ·125	— 8 ·41	— 3· 532	·420
March 1,	—·032	13 43 ·098	13 43 ·563	— ·465	21 ·549	— 10 ·02	— 2· 067	·206
" 3,	—·057	13 01 ·213	13 01 ·245	— ·032	22 ·545	— 0 ·72	— 0· 266	·369
April 2,	—·130	10 48 ·970	10 49 ·370	— ·400	27 ·155	— 10 ·86	— 2· 345	·216
" 27,	+ ·030	12 21 ·980	12 21 ·979	+ ·001	23 ·686	+ 0 ·02	+ 0· 005	·223
" 28,	—·185	11 29 ·735	11 30 ·088	— ·353	25 ·479	— 9 ·00	— 2· 309	257
May 28,	—·105	10 08 ·445	10 08 ·804	— ·359	29 ·039	— 10 ·43	— 2· 060	·198
" 29,	—·177	10 04 ·603	10 04 ·345	— ·342	29 ·337	— 10 ·03	— 2· 164	·215
June 2,	—·107	11 19 ·773	11 20 ·058	— ·285	26 ·138	— 7 ·45	— 2. 180	·293
July 28,	+ ·140	11 26 ·350	11 26 ·596	— ·246	25 ·812	— 6 ·35	— 1. 588	·250
August 31,	+ ·227	9 14 ·917	9 15 ·981	— ·264	31 ·889	— 8 ·42	— 1. 563	·184
Septem. 25,	+ ·248	9 52 ·348	9 52 ·729	— ·381	29 ·761	— 11 ·34	— 2· 346	·207
October 23,	+ ·480	9 36 ·170	9 36 ·251	— ·081	30 ·625	— 2 ·48	— 0· 432	·174
" 25,	—·042	9 16 ·628	9 16 ·778	— ·150	31 ·841	— 4 ·78	— 0· 942	·197
" 26,	—·050	9 25 ·740	9 26 ·024	— ·284	31 ·405	— 8 ·92	— 1· 808	·203
Decem. 18,	+ ·035	9 08 085	9 08 ·081	+ ·004	32 ·249	+ 0 ·13	+ 0· 021	·160
" 26,	—·026	13 56 ·854	13 56 ·941	— ·087	21 ·256	— 1 ·85	— 0· 849	·459

Sixty-four corresponding observations of the *first* limb, the mean resulting correction from which, by weight, is

— 7ˢ 51.

WASHINGTON AND EDINBURGH.

Moon's second limb.

YEAR AND DAY.			B	I'	I_0	e	n	ne	$hh \times ne$	hh
			s	m s	m s	s		s	s	
1839.	February	6,	—·502	10 40·718	10 41·093	—·375	27·883	—10·16	—2·690	·257
	March	1,	—·285	8 51·015	8 50·941	+·074	33·352	+ 2·47	+0·370	·150
	"	30,	—·070	9 03·410	9 03·550	—·140	32·724	— 4·58	—0·713	·156
	Novem.	21,	—·027	11 33·413	11 33·318	+·095	20·310	+ 1·93	+0·931	·484
1840.	January	18,	—·207	12 43·383	12 43·099	+·284	23·002	+ 6·53	+2·469	·378
	April	16,	—·201	9 41·379	9 41·431	—·052	30·455	— 1·58	—0·313	·198
	"	17,	—·065	10 10·125	10 09·952	+·173	29·203	+ 5·05	+0·987	·195
	July	16,	—·100	10 00·490	10 00·765	—·275	29·388	— 8·08	—0·851	·105
	Septem.	11,	—·240	10 05·060	10 05·189	—·429	29·328	—12·58	—1·272	·101
	"	13,	+·320	10 56·850	10 57·112	—·262	27·156	— 7·12	—1·206	·169
	October	11,	+·013	11 41·683	11 41·872	—·189	25·458	— 4·81	—1·392	·289
	"	12,	—·355	12 37·085	12 37·111	—·026	23·599	— 0·61	—0·180	·293
	Novem.	10,	—·240	14 15·770	14 15·919	—·149	20·800	— 3·10	—1·194	·385
	Decem.	10,	—·160	13 54·880	13 54·969	—·089	21·014	— 1·87	—0·794	·425
	"	17,	+·010	9 53·690	9 53·838	—·118	29·935	— 4·43	—0·618	·139
1841.	January	8,	— 0·0	12 31·380	12 31·351	+·029	23·343	+ 0·68	+0·155	·229
	March	8,	+·130	10 26·850	10 27·121	—·271	28·259	— 7·66	—1·128	·147
	May	6,	+·007	11 30·997	11 30·856	+·141	25·701	+ 3·62	+1·029	·284
	June	3,	+·097	11 31·907	11 32·052	—·145	25·634	— 3·72	—1·131	·304
	"	4,	+·210	11 28·730	11 28·391	+·339	25·541	+ 8·66	+1·476	·171
	August	31,	+·227	9 14·917	9 15·181	—·264	31·889	— 8·42	—1·563	·184
	Septem.	30,	+·180	9 56·930	9 57·062	—·132	29·845	— 3·94	—0·553	·140
	Novem.	5,	—·007	11 29·373	11 29·416	—·043	25·541	— 1·10	—0·316	·287

Twenty-three corresponding observations of the *second* limb, the mean resulting correction from which, by weight, is

$$-1^s.57.$$

Eighty-seven corresponding observations of both limbs giving a mean correction, by weight, of

$$-5^s.86.$$

WASHINGTON AND OXFORD.

Moon's first limb.

YEAR AND DAY.			B	I'	I_0	e	n	ne	$hh \times ne$	hh
			s	m s	m s	s		s	s	
1840.	February	12,	—·037	14 08·623	14 09·217	—·493	21·434	—10·56	—4·312	·408
	May	13,	—·167	9 49·013	9 48·255	+·758	31·021	+23·51	+4·582	·195
	June	13,	—·057	11 28·923	11 29·169	—·246	26·472	— 6·51	—1·742	·268
	July	13,	+·087	11 32·107	11 32·501	—·394	26·109	—10·29	—2·830	·275
	Septem.	7,	+·190	11 04·960	11 05·599	—·639	27·217	—17·39	—1·937	·284
	"	8,	+·140	10 42·680	10 43·138	—·458	28·168	—12·90	—2·633	·158
	October	6,	+·518	10 26·678	10 26·601	+·077	28·913	+ 2·23	+0·532	·239
	"	7,	+·118	10 16·998	10 17·305	—·307	29·112	— 9·03	—2·087	·231
	"	8,	+·260	10 19·970	10 20·215	—·245	29·368	— 7·20	—1·668	·232
	"	9,	+·235	10 37·475	10 37·776	—·301	28·632	— 8·62	—1·752	·203

YEAR AND DAY.	*B*	*I'*	I_o	*e*	*n*	*ne*	*hh*×*ne*.	*hh*
	s	m s	m s	s		s	s	
November 2,	+·050	10 20 ·070	10 20 ·320	—·250	29·213	— 7·30	— 1·799	·246
" 4,	—·041	10 05 ·129	10 05 ·303	—·174	30·068	— 5·23	— 1·130	·216
" 6,	+·152	10 49 ·012	10 49 ·268	—·256	28·184	— 7·22	— 1·665	·231
December 1,	+·006	9 47 ·396	9 47 ·959	—·563	30·905	—17·40	— 2·996	·167
" 2,	+·080	9 52 .360	9 52 ·635	—·275	30·749	— 8·45	— 2·235	·264
" 3,	+·103	10 13 ·913	10 14 ·060	—·127	29·767	— 3·78	— 0·800	·212
" 8,	—·106	15 05 ·994	15 06 ·016	—·022	20·135	— 0·44	— 0·228	·514
1841. February 3,	—·011	14 15 ·466	14 15 ·720	—·254	21·147	— 5·37	— 2·576	·480
" 4,	—·098	13 24 ·792	13 24 ·973	—·181	22·413	— 4·06	— 1·798	·443
April 27,	+·130	12 41 ·510	12 41 ·444	+·066	23·686	+ 1·56	+ 0·407	·260
May 1,	+·190	10 25 ·240	10 25 ·388	—·148	29·939	— 4·43	— 0·530	·120
June 29,	+·020	11 25 ·920	11 26 ·405	—·485	26·578	—12·89	— 2·280	·177
October 21,	—·055	10 50 ·355	10 50 ·861	—·506	27·773	—14·06	— 2·694	·192
" 25,	+·017	9 30 ·867	9 31 ·271	—·404	31·841	—12·86	— 2·667	·207
Novem. 24,	+·200	10 18 ·510	10 18 ·509	+·001	29·610	+ 0·03	+ 0·003	·104
1842. February 21,	—·295	13 39 ·465	13 40 ·261	—·796	22·110	—17·60	— 7·807	·444
" 22,	—·154	13 11 ·386	13 11 ·959	—·573	22·852	—13·10	— 5·212	·398
April 20,	+·433	11 28 ·883	11 29 ·204	—·321	26·324	— 8·45	— 2·623	·303
" 21,	+·198	11 24 ·208	11 24 ·218	—·010	26·582	— 0·26	— 0·073	·277
" 22,	+·311	11 32 ·441	11 32 ·924	—·483	26·300	—12·70	— 3·651	·287
" 23,	+·195	11 52 ·185	11 52 ·868	—·683	25·592	—17·48	— 3·632	·208
June 21,	—·247	12 30 ·123	12 30 ·729	—·606	24·171	—14·65	— 4·701	·321

Thirty-two corresponding observations of the *first* limb, the mean resulting correction from which, by weight, is

$$-7^s.81.$$

WASHINGTON AND OXFORD.

Moon's second limb.

YEAR AND DAY.	*B*	*I'*	I_o	*e*	*n*	*ne*	*hh*×*ne*	*hh*
	s	m s	m s	s		s	s	
1840. July 15,	+·033	10 40 ·183	10 40 ·597	—·414	28·251	—11·70	— 2·747	·235
August 14,	—·080	10 06 ·630	10 06 ·650	—·020	29·967	— 0·60	— 0·111	·186
Septem. 11,	+·090	10 20 ·990	10 21 ·229	—·239	29·328	— 7·01	— 1·630	·233
October 12,	—·065	12 56 ·905	12 56 ·674	+·231	23·599	+ 5·45	+ 1·957	·359
Novem. 9,	+·088	13 47 ·978	13 47 ·871	+·107	22·145	+ 2·37	+ 1·085	·458
" 10,	—·032	14 37 ·948	14 38 ·115	—·167	20·800	— 3·47	— 1·900	·547
1841. February 5,	—·105	12 24 ·275	12 24 ·813	—·538	24·184	—13·01	— 2·491	·193
March 8,	+·326	10 43 ·106	10 43 ·454	—·338	28·259	— 9·55	— 2·220	·232
May 6,	+·132	11 49 ·112	11 48 ·814	+·298	25·701	+ 7·66	+ 2·603	·340
June 3,	+·052	11 49 ·822	11 50 ·060	—·238	25·634	— 6·10	— 2·071	·339
" 4,	+·415	11 46 ·355	11 46 ·344	+·011	25·541	+ 0·28	+ 0·072	·256
Septem. 30,	+·253	10 12 ·413	10 12 ·526	—·113	29·845	— 3·37	— 0·796	·236
1842. March 26,	—·125	11 51 ·665	11 52 ·020	—·375	27·011	—10·13	— 2·314	·228

Thirteen corresponding observations of the *second* limb, the mean resulting correction from which, by weight, is

$$-2^s.77.$$

Forty-five corresponding observations of both limbs, giving a mean correction, by weight, of

$$-6^s.25.$$

WASHINGTON AND GREENWICH.

Moon's first limb.

YEAR AND DAY.			B	I'	$I_\circ$	e	n	ne	$hh \times ne$	hh
			s	m s	m s	s		s	s	
1839.	March	24,	+·180	11 26·210	11 26·837	—·627	26·678	— 16·73	— 4·576	·274
	"	25,	+·020	10 31·400	10 31·755	—·355	28·890	— 10·26	— 1·549	·151
	"	27,	+·265	9 26·425	9 26·614	—·189	32·491	— 6·11	— 1·132	·184
	April	19,	—·100	13 01·960	13 02·056	—·096	23·436	— 2·25	— 0·467	·207
	"	20,	+·150	11 57·060	11 56·881	+·179	25·535	+ 4·57	+ 0·799	·175
	"	25,	—·525	9 10·375	9 10·299	+·076	33·607	+ 2·55	+ 0·440	·172
	"	26,	—·140	9 20·020	9 20·266	—·246	33·093	— 8·14	— 1·085	·133
	July	21,	+·050	11 42·160	11 42·046	+·114	26·512	+ 3·02	+ 0·942	·312
	August	23,	—·390	11 50·880	11 51·137	—·257	25·884	— 6·65	— 0·846	·127
	Septem.	18,	—·033	12 17·757	12 17·673	+·084	24·993	+ 2·10	+ 0·491	·234
	"	19,	+·060	11 56·960	11 57·033	—·073	25·696	— 1·88	— 0·415	·221
	"	22,	—·040	11 28·840	11 28·835	+·005	26·875	+ 0·13	+ 0·027	·202
	October	16,	—·035	11 45·595	11 45·542	+·053	26·121	+ 1·38	+ 0·395	·285
	"	19,	—·044	11 17·516	11 17·626	—·110	27·316	— 3·01	— 0·672	·224
	Novem.	16,	+·010	11 03·440	11 03·095	+·345	27·950	+ 9·64	+ 2·625	·272
	"	20,	—·110	14 31·740	14 32·126	—·386	21·342	— 8·24	— 2·436	·296
1840.	January	12,	+·320	11 44·620	11 44·829	—·209	26·436	— 5·53	— 1·539	·278
	"	13,	+·035	12 44·005	12 44·466	—·461	24·397	— 11·25	— 4·415	·393
	"	16,	—·060	14 49·870	14 50·749	—·879	20·732	— 18·22	— 6·191	·340
	February	12,	+·100	14 22·910	14 23·285	—·375	21·431	— 8·04	— 4·087	·509
	April	10,	+·225	11 42·035	11 42·180	—·145	26·090	— 3·78	— 1·082	·286
	"	12,	—·015	10 11·555	10 11·644	—·089	30·063	— 2·68	— 0·576	·216
	"	13,	—·030	9 49·870	9 49·988	—·188	31·250	— 5·89	— 1·318	·224
	"	15,	—·073	9 50·097	9 50·506	—·409	31·375	— 12·83	— 3·854	·222
	May	13,	—·110	9 58·570	9 57·974	+·596	31·021	+ 18·48	+ 3·740	·202
	June	7,	—·080	9 49·190	9 49·436	—·246	31·273	— 7·69	— 1·149	·149
	Septem.	6,	+·025	11 38·145	11 38·157	—·012	26·476	— 0·32	— 0·086	·272
	"	7,	—·044	11 16·226	11 16·676	—·450	27·217	— 12·25	— 3·576	·292
	"	10,	—·097	10 26·833	10 27·158	—·325	29·460	— 9·57	— 1·976	·206
	October	6,	+·075	10 36·995	10 37·017	—·022	28·943	— 0·64	— 0·175	·275
	"	7,	—·008	10 27·672	10 27·547	+·125	29·412	+ 3·68	+ 1·061	·289
	"	9,	+·216	10 47·966	10 48·306	—·340	28·632	— 9·73	— 2·570	·264
	Novem.	2,	—·190	10 30·550	10 30·639	—·089	29·213	— 2·60	— 0·445	·171
	"	4,	—·185	10 15·355	10 15·307	+·048	30·068	+ 1·44	+ 0·373	·258
	December	2,	+·180	10 02·390	10 02·443	—·053	30·749	— 1·63	— 0·232	·142
	"	8,	+·029	15 20·929	15 20·990	—·061	20·135	— 1·23	— 0·703	·572
1841.	January	3,	—·300	13 30·920	13 31·491	—·571	23·004	— 13·13	— 3·641	·277
	April	2,	—·257	11 17·243	11 17·463	—·220	27·155	— 5·97	— 1·774	·297
	"	5,	+·100	10 53·910	10 53·970	—·060	28·317	— 1·70	— 0·242	·142
	"	27,	+·150	12 54·320	12 54·167	+·153	23·686	+ 3·62	+ 0·943	·260
	May	28,	—·003	10 31·787	10 35·075	—·288	29·039	— 8·36	— 1·878	·224
	June	3,	+·220	12 02·260	12 01·825	+·435	25·634	+ 11·15	+ 3·304	·296
	"	30,	+·001	11 54·111	11 54·051	+·060	25·931	+ 1·56	+ 0·409	·263
	July	28,	+·105	11 55·915	11 56·091	—·176	25·812	— 4·54	— 1·327	·292
	August	28,	—·066	10 36·371	10 36·646	—·272	28·890	— 7·86	— 2·051	·261
	"	29,	+·020	10 09·400	10 09·356	+·044	30·204	+ 1·33	+ 0·319	·240
	"	30,	—·220	9 48·770	9 49·281	—·511	31·277	— 15·98	— 2·385	·149
	October	21,	—·030	11 01·640	11 01·716	—·076	27·773	— 2·11	— 0·334	·158
	"	23,	+·155	10 00·885	10 01·160	—·275	30·625	— 8·42	— 1·748	·208
	"	24,	+ 250	9 44·680	9 44·753	—·073	31·548	— 2·30	— 0·312	·135
	"	25,	—·074	9 40·546	9 40·740	—·194	31·841	— 6·18	— 1·301	·216
	Novem.	24,	+·085	10 28·605	10 28·692	—·087	29·610	— 2·58	— 0·572	·222
	Decem.	18,	+·010	9 31·720	9 31·738	—·018	32·249	— 0·58	— 0·082	·140

YEAR AND DAY.	B	l'	l_o	e	n	ne	$hh \times ne$	hh
	s	m s	m s	s		s	s	
1842. January 17,	+ ·070	9 36 ·750	9 36· 829	— ·079	32 ·151	— 2 ·54	— 0 ·359	·141
" 23,	+ ·021	14 27 ·581	14 27· 713	— ·132	21 ·359	— 2 ·82	— 1 ·121	·398
February 19,	— ·249	13 42 ·381	13 42· 599	— ·218	22 ·633	— 4 ·93	— 2 ·203	·447
" 21,	— ·364	13 53 ·346	13 53· 907	— ·561	22 ·110	— 12 ·41	— 4 ·434	·357
April 20,	— ·160	11 40 ·730	11 40· 653	+ ·077	26 ·324	+ 2 ·03	+ 0 ·569	·281
" 22,	+ ·180	11 44 ·410	11 44· 381	+ ·029	26 ·300	+ 0 ·76	+ 0 ·194	·255
" 23,	+ ·005	12 01 ·475	12 04· 646	— ·171	25 ·592	— 4 ·38	— 0 ·988	·226
June 21,	— ·017	12 43 ·093	12 43· 202	— ·109	24 ·171	— 2 ·63	— 0 ·982	·373

Sixty corresponding observations of the *first* limb, the mean resulting correction from which, by weight, is

$$-3^s.75.$$

WASHINGTON AND GREENWICH.

Moon's second limb.

YEAR AND DAY.	B	l'	l_o	e	n	ne	$hh \times ne$	hh
	s	m s	m s	s		s	s	
1839. February 4,	— ·160	9 44 ·050	9 43 ·602	+ ·448	32 ·349	+ 14 ·49	+ 2 ·022	·140
March 3,	— ·110	9 33 ·570	9 33 ·572	— ·002	32 ·362	— 0 ·06	— 0 ·009	·139
Septem. 26,	+ ·045	13 49 685	13 50 ·051	— ·366	22 ·378	— 8 ·19	— 3 ·186	·389
" 28,	— ·264	14 07 ·306	14 07 ·512	— ·206	21 ·748	— 4 ·48	— 1 ·689	·377
October 25,	— ·010	14 45 ·400	14 45 ·778	— ·378	20 ·837	— 7 ·88	— 2 ·441	·310
Novem. 21,	+ ·190	15 10 ·730	15 10 ·748	— ·018	20 ·340	— 0 ·58	— 0 ·274	·472
Decem. 25,	+ ·057	9 50 ·647	9 50 ·907	— ·260	31 ·126	— 8 ·09	— 1 ·829	·226
1840. March 21,	+ ·030	10 46 ·520	10 46 ·558	— ·038	28 ·729	— 1 ·09	— 0 ·193	·178
April 16,	— ·130	10 09 ·150	10 09 ·379	— ·229	30 ·455	— 6 ·97	— 1 ·638	·235
" 17,	+ ·070	10 36 ·370	10 36 ·085	+ ·285	29 ·203	+ 8 ·32	+ 1 ·425	·171
May 16,	+ ·020	11 24 ·500	11 24 ·669	— ·169	27 ·114	— 4 ·58	— 1 ·365	·298
June 19,	+ ·299	10 18 ·479	10 18 ·461	+ ·018	29 ·818	+ 0 ·54	+ 0 ·115	·214
July 15,	— ·140	10 50 ·960	10 51 ·368	— ·408	28 ·251	— 11 ·53	— 2 ·812	·244
" 16,	— ·140	10 26 ·390	10 26 ·741	— ·351	29 ·388	— 10 ·32	— 2 ·222	·215
" 19,	+ ·070	10 23 ·050	10 23 ·135	— ·085	29 ·773	— 2 ·53	— 0 ·417	·165
August 14,	+ ·110	10 16 ·420	10 16 ·710	— ·290	29 ·967	— 8 ·69	— 1 ·413	·163
Septem. 11,	+ ·120	10 31 ·130	10 31 ·510	— ·380	29 ·328	— 11 ·15	— 1 ·634	·147
" 12,	— ·062	10 50 ·428	10 50 ·655	— ·227	28 ·533	— 6 ·48	— 1 ·830	·283
" 13,	+ ·117	11 24 ·807	11 25 ·102	— ·295	27 ·156	— 8 ·01	— 2 ·379	·297
" 16,	+ ·080	13 51 ·230	13 54 ·432	— ·202	22 ·263	— 4 ·50	— 1 ·766	·393
October 14,	+ ·350	14 33 ·510	14 33 ·018	+ ·492	21 ·214	+ 10 ·43	+ 2 ·926	·280
Novem. 10,	— ·105	14 52 ·295	14 52 ·613	— ·318	20 ·800	— 6 ·61	— 2 ·975	·450
" 13,	+ ·005	13 28 ·875	13 28 ·916	— ·041	22 ·640	— 0 ·93	— 0 ·353	·380
Decem. 10,	+ ·040	14 31 ·120	14 31 ·207	— ·087	21 ·014	— 1 ·83	— 0 ·604	·331
1841. January 8,	— ·050	13 03 ·700	13 04 ·021	— ·321	23 ·343	— 7 ·49	— 2 ·028	·268
March 8,	— ·070	10 53 ·990	10 54 ·124	— ·134	28 ·259	— 3 ·79	— 0 ·692	·183
May 6,	— ·180	12 00 ·510	12 00 ·516	— ·006	25 ·701	— 0 ·15	— 0 ·051	·332
June 4,	+ ·333	11 58 ·253	11 58 ·081	+ ·172	25 ·541	+ 4 ·39	+ 1 ·402	·319
July 8,	+ ·267	9 33 ·287	9 33 ·489	— ·202	32 ·269	— 6 ·52	— 1 ·371	·210
September 1,	+ ·390	9 40 ·570	9 40 ·848	— ·278	31 ·869	— 8 ·86	— 2 ·037	·230
" 2,	+ ·045	9 55 ·535	9 55 ·592	— ·057	31 ·153	— 1 ·78	— 0 ·356	·201
" 5,	— ·054	11 56 ·936	11 57 ·535	— ·599	25 ·974	— 15 ·56	— 4 ·989	·321
October 5,	+ ·010	13 48 ·960	13 49 ·017	— ·087	22 ·328	— 1 ·94	— 0 ·569	·293

YEAR AND DAY.	B	I'	I_0	e	n	ne	$hh \times ne$	hh
	s	m s	m s	s		s	s	
1841, Novem. 30,	+ ·750	14 08 ·530	14 07 ·910	+ ·620	21 ·701	+13 ·46	+ 3 ·257	·237
Decem. 3,	+ ·051	12 40 ·191	12 40 ·311	— ·120	26 ·231	— 3 ·15	— 1 ·002	·318
1842, January 26,	— ·210	13 10 ·980	13 11 ·459	— ·179	23 ·215	—11 ·12	— 4 ·519	·406
" 31,	— ·210	11 37 ·680	11 37 ·459	+ ·221	26 ·477	+ 5 ·85	+ 1 ·180	·202
April 25,	+ ·130	12 53 ·600	12 53 ·668	— ·068	23 ·950	— 1 ·63	— 0 ·415	·255
" 26,	+ ·175	13 02 ·215	13 02 ·595	— ·380	23 ·621	— 8 ·98	— 3 ·132	·349
" 28,	+ ·232	12 21 ·352	12 21 ·100	+ ·252	24 ·808	+ 6 ·25	— 2 ·176	·348
" 29,	+ ·048	11 39 ·088	11 39 ·118	— ·038	26 ·187	— 0 ·99	— 0 ·212	·213

Forty-one corresponding observations of the *second* limb, the mean resulting correction from which, by weight, is

$$-3^s.38.$$

One hundred and one corresponding observations of both limbs, giving a mean correction, by weight, of

$$-3^s.59.$$

WASHINGTON AND CAMBRIDGE (ENGLAND.)

Moon's first limb.

YEAR AND DAY.	B	I'	I_0	e	n	ne	$hh \times ne$	hh
	s	m s	m s	s		s	s	
1839, February 19,	— ·120	12 38 ·160	12 38 ·276	— ·126	24 ·535	— 3 ·09	— 0 ·750	·243
" 21,	+ ·020	13 32 ·860	13 33 ·455	— ·595	22 ·783	— 13 ·56	— 3 ·814	·281
March 24,	+ ·162	11 27 ·342	11 27 ·698	— ·356	26 ·678	— 9 ·50	— 3 ·096	·326
" 25,	+ ·092	10 35 ·542	10 35 ·550	— ·008	28 ·890	— 0 ·23	— 0 ·064	·278
" 27,	+ ·363	9 27 ·213	9 27 ·321	— ·108	32 ·491	— 7 ·00	— 1 ·452	·207
April 19,	— ·220	13 02 ·750	13 03 ·033	— ·283	23 ·436	— 6 .63	— 1 ·763	·266
" 21,	+ ·190	10 56 ·870	10 56 ·395	+ ·475	27 ·939	+ 13 ·27	+ 3 ·310	·249
" 22,	+ ·145	10 07 ·295	10 07 ·213	+ ·082	30 ·255	+ 2 ·48	+ 0 ·528	·213
" 25,	— ·365	9 11 ·065	9 10 ·983	+ ·082	33 ·607	+ 2 ·76	+ 0 ·475	·172
July 21,	+ ·010	11 43 ·050	11 42 ·912	+ ·138	26 ·512	+ 3 ·66	+ 0 ·760	·208
Septem. 18,	— ·055	12 18 ·525	12 18 ·592	— ·067	24 ·993	— 1 ·67	— 0 ·522	·312
" 19,	— ·520	11 57 ·540	11 57 ·927	— ·387	25 ·696	— 9 ·91	— 2 ·199	·221
" 22,	+ ·070	11 29 ·780	11 29 ·689	+ ·091	26 ·875	+ 2 ·45	+ 0 ·674	·276
October 16,	+ ·052	11 46 ·602	11 46 ·421	+ ·181	26 ·121	+ 4 ·73	+ 1 ·619	·342
" 19,	— ·087	11 18 ·323	11 18 ·467	— ·144	27 ·316	— 3 ·93	— 0 ·973	·247
" 20,	— ·040	11 36 ·460	11 36 ·736	— ·276	26 ·671	— 7 ·36	— 1 ·511	·205
Novem. 16,	+ ·086	11 04 ·446	11 03 ·917	+ ·529	27 ·950	+ 14 ·79	+ 4 ·393	·279
" 18,	+ ·039	12 25 ·299	12 25 ·700	— ·401	25 ·028	— 9 ·96	— 3 ·715	·370
" 20,	+ ·081	14 33 ·051	14 33 ·203	— ·152	21 ·342	— 3 ·24	— 1 ·626	·513
Decem. 12,	— ·070	10 33 ·850	10 33 ·913	— ·063	29 ·159	— 1 ·84	— 0 ·315	·172
1840. January 12,	+ ·160	11 45 ·510	11 45 ·698	— ·188	26 ·436	— 4 ·97	— 1 ·558	·313
" 13,	+ ·170	12 45 ·460	12 45 ·408	+ ·052	24 ·397	+ 1 ·27	+ 0 ·415	·327
February 11,	— ·065	14 00 ·565	14 01 ·253	— ·688	22 ·117	— 15 ·21	— 7 ·271	·478
" 12,	+ ·053	14 23 ·743	14 24 ·357	— ·614	21 ·434	— 13 ·16	— 6 ·273	·477
March 13,	+ ·095	12 29 ·595	12 29 ·559	+ ·036	24 ·487	+ 0 ·88	— 0 ·343	·390
April 8,	— ·080	13 46 ·850	13 47 ·207	— ·357	22 ·213	— 7 ·93	— 2 ·129	·268
" 10,	+ ·092	11 43 ·122	11 43 ·060	+ ·062	26 ·090	+ 1 ·62	+ 0 ·555	·343
" 12,	— ·010	10 12 ·350	10 12 ·408	— ·058	30 ·063	— 1 ·74	— 0 ·376	·216

YEAR AND DAY.			B	I'	$I_\circ$	e	n	ne	$hh \times ne$	hh
			s	m s	m s	s		s	s	
1840,	April	13,	— ·140	9 50·740	9 50·723	+ ·017	31·250	+ 0·53	+ 0·127	·239
	"	15,	+ ·253	9 51·063	9 51·243	— ·180	31·375	— 5·65	— 1·256	·222
	May	13,	— ·097	9 59·263	9 58·715	+ ·548	31·021	+ 17·00	+ 3·869	·228
	June	13,	— ·177	11 41·273	11 41·427	— ·154	26·472	— 4·08	— 1·274	·312
	July	10,	— ·020	11 34·610	11 34·068	+ ·542	27·513	+ 14·91	+ 3·835	·257
	"	11,	— ·037	11 53·243	11 53·192	+ ·051	26·000	+ 1·33	+ 0·429	·324
	"	13,	+ ·005	11 44·855	11 44·893	— ·038	26·109	— 0·99	— 0·283	·286
	"	14,	— ·180	11 19·620	11 20·340	— ·725	27·090	— 19·64	— 3·907	·199
	August	6,	— ·055	11 26·375	11 26·538	— ·163	27·066	— 4·41	— 1·172	·266
	"	9,	— ·310	11 51·750	11 51·989	— ·239	25·945	— 6·20	— 2·017	·325
	"	11,	— ·035	11 08·115	11 08·231	— ·116	27·579	— 3·20	— 0·819	·256
	Septem.	8,	— ·167	10 54·493	10 54·656	— ·163	28·168	— 4·59	— 1·267	·276
	October	6,	+ ·272	10 38·002	10 37·811	+ ·191	28·943	+ 5·53	+ 1·542	·279
	"	7,	+ ·162	10 28·322	10 28·328	— ·006	29·412	— 0·18	— 0·050	·281
	"	8,	+ ·157	10 31·327	10 31·265	+ ·062	29·368	+ 1·82	+ 0·493	·271
	"	9,	+ ·190	10 49·040	10 49·109	— ·069	28·632	— 1·97	— 0·469	·238
	Novem.	2,	+ ·012	10 31·672	10 31·425	+ ·247	29·213	+ 7·22	+ 1·975	·274
	"	4,	+ ·119	10 16·379	10 16·071	+ ·308	30·068	+ 9·26	+ 2·376	·257
	Decem.	2,	+ ·083	10 03·293	10 03·190	+ ·103	30·749	+ 3·17	+ 0·733	·232
	"	3,	+ ·213	10 24·983	10 24·960	+ ·023	29·767	+ 0·68	+ 0·169	·247
1842.	January	19,	+ ·020	10 50·140	10 50·274	— ·134	28·700	— 3·85	— 0·570	·148
	Feb.	17,	— ·040	12 04·630	12 04·849	— ·219	25·747	— 5·61	— 1·242	·220
	"	19,	— ·090	13 43·340	13 43·617	— ·277	22·633	— 6·27	— 2·882	·460
	"	21,	— ·162	13 54·637	13 54·868	— ·231	22·110	— 5·11	— 2·254	·461
	"	24,	+ ·023	12 19·713	12 19·388	+ ·325	24·936	+ 8·10	+ 2·854	·352
	April	20,	+ ·180	11 41·620	11 41·525	+ ·095	26·324	+ 2·50	+ 0·790	·316
	"	22,	+ ·184	11 45·464	11 45·254	+ ·210	26·300	+ 5·52	+ 1·853	·336
	"	23,	+ ·035	12 05·625	12 05·544	+ ·081	25·592	+ 2·07	+ 0·489	·236
	June	21,	— ·140	12 44·210	12 44·153	+ ·057	24·171	+ 1·38	+ 0·336	·250

Fifty-seven corresponding observations of the *first* limb, the mean resulting correction from which is, by weight,

$$-1^s.58.$$

WASHINGTON AND CAMBRIDGE.

Moon's second limb.

YEAR AND DAY.			B	I'	$I_\circ$	e	n	ne	$hh \times ne$	hh
			s	m s	m s	s		s	s	
1839.	March	1,	— ·070	9 14·000	9 14·512	— ·512	33·352	— 17·08	— 2·242	·131
	August	25,	+ ·630	11 16·280	11 16·560	— ·280	27·333	— 7·65	— 1·994	·261
	"	31,	— ·540	13 59·760	14 00·544	— ·774	22·041	— 17·06	— 4·729	·277
	Novem.	21,	+ ·017	15 11·777	15 11·881	— ·104	20·340	— 2·11	— 1·120	·529
	"	22,	± ·000	15 03·430	15 03·463	— ·033	20·410	— 0·67	— 0·354	·526
	Decem.	20,	— ·252	14 55·068	14 55·373	— ·305	20·566	— 6·27	— 3·465	·552
1840,	April	16,	— ·071	10 09·759	10 10·134	— ·375	30·455	— 11·42	— 2·294	·201
	"	17,	+ ·090	10 36·830	10 36·872	— ·042	29·203	— 1·23	— 0·210	·171
	May	16,	+ ·055	11 25·555	11 25·516	+ ·039	27·114	+ 1·06	+ 0·336	·318
	July	15,	— ·237	10 51·563	10 52·181	— ·618	28·251	— 17·46	— 4·791	·271
	"	16,	— ·185	10 27·145	10 27·523	— ·378	29·388	— 11·11	— 2·441	·220
	August	14,	+ .153	10 17·573	10 17·477	+ ·096	29·967	+ 2·88	+ 0·702	·244
	Septem.	11,	+ ·265	10 31·975	10 32·294	— ·319	29·328	— 9·36	— 2·117	·226

YEAR AND DAY.	B	I'	I_0	e	n	ne	$hh \times ne$	hh
	s	m s	m s	s		s	s	
1840, Septem. 12,	+ ·102	10 50 ·982	10 51 ·160	— ·478	28 ·533	— 13 ·64	— 3 ·913	·287
" 13,	+ ·095	11 25 ·595	11 25 ·948	— ·353	27 ·156	— 9 ·58	— 2 .530	·261
October 11,	— ·052	12 12 ·248	12 12 ·742	— ·494	25 ·458	— 12 ·58	— 1 ·517	·524
" 12,	± ·000	13 10 ·300	13 10 ·425	— ·125	23 ·599	— 2 ·95	— 1 ·723	·376
Novem. 9,	— ·102	14 02 ·008	14 02 ·524	— ·516	22 ·145	— 11 ·13	— 5 ·442	·476
" 10,	— ·054	14 53 ·476	14 53 ·741	— ·265	20 ·800	— 5 ·51	— 3 ·100	562
1842. January 27,	— ·177	12 26 ·163	12 26 ·517	— ·354	24 ·616	— 8 ·72	— 3 ·146	·361
March 26,	— ·010	12 01 ·490	12 01 ·700	— ·210	27 ·011	— 5 ·67	— 1 ·703	·300
April 25,	+ ·192	12 54 ·502	12 54 ·627	— ·125	23 ·950	— 2 ·99	— 1 ·219	·407
" 26,	+ ·265	13 03 ·385	13 03 ·568	— ·183	23 ·621	— 4 ·32	— 1 ·509	·349

Twenty-three corresponding observations of the *second* limb, the mean resulting correction from which, by weight, is

$$-6^s.96.$$

Eighty corresponding observations of both limbs, giving a mean correction, by weight, of

$$-3^s.31.$$

WASHINGTON AND HAMBURG.

Moon's first limb.

YEAR AND DAY.	B	I'	I_0	e	n	ne	$hh \times ne$	hh
	s	m s	m s	s		s	s	
1839, January 23,	— ·090	14 16 ·050	14 16 ·887	— ·837	24 ·494	— 20 ·50	— 9 ·240	·451
" 24,	+ ·005	15 00 ·915	15 01 ·633	— ·688	23 ·253	— 16 ·00	— 7 ·120	·445
February 19,	+ ·180	14 14 ·820	14 14 ·850	— ·030	24 ·535	— 0 ·73	— 0 ·221	·300
" 21,	+ ·340	15 17 ·160	15 17 .501	— ·341	22 ·783	— 7 ·84	— 4 ·088	·522
March 25,	— ·001	11 57 ·746	11 57 ·512	+ ·234	28 ·890	+ 6 ·76	+ 2 ·224	·529
" 26,	— ·105	11 11 ·355	11 11 ·443	— ·088	30 ·930	— 2 ·72	— 0 ·641	·235
April 20,	— ·250	13 30 ·490	13 30 ·749	— ·259	25 ·535	— 6 ·61	— 1 ·484	·224
" 22,	+ ·017	11 25 ·417	11 25 ·660	— ·243	30 ·255	— 7 ·35	— 2 ·171	·296
May 22,	+ ·010	10 21 ·990	10 22 ·931	— ·941	33 ·498	— 31 ·52	— 5 ·071	·161
June 20,	— 210	10 41 ·020	10 41 ·144	— ·124	32 ·664	— 4 ·05	— 0 ·685	·169
" 25,	— ·555	11 10 ·915	11 11 ·173	— ·228	24 ·605	— 5 ·61	— 2 ·189	·390
Septem. 19,	+ ·010	13 30 ·150	13 30 ·237	— ·087	25 ·696	— 2 ·24	— 0 ·557	·249
October 20,	± ·000	13 05 ·910	13 05 ·471	+ ·439	26 ·671	+ 11 ·71	+ 2 ·971	·254
Novem. 18,	+ ·156	13 59 ·936	14 00 ·334	— ·398	25 ·028	— 9 ·96	— 4 ·289	·431
" 20,	— ·110	16 23 ·840	16 24 ·197	— ·357	21 ·342	— 7 ·62	— 4 ·026	·528
1840. January 13,	+ ·107	14 22 ·037	14 22 ·468	— ·431	24 ·397	— 10 ·51	— 4 ·783	·455
" 15,	— ·037	16 30 ·783	16 31 ·241	— ·458	21 ·145	— 9 ·68	— 5 ·861	·605
February 12,	+ ·069	16 14 ·429	16 14 ·977	— ·548	21 ·434	— 14 ·79	— 8 ·664	·586
March 11,	— ·063	15 54 ·387	15 54 ·818	— ·431	21 ·807	— 9 ·40	— 5 ·350	·569
April 10,	— ·035	13 13 ·715	13 14 ·055	— ·340	26 ·090	— 8 ·87	— 3 ·763	·424
" 12,	— ·055	11 31 ·115	11 31 ·335	— ·220	30 ·063	— 6 ·61	— 1 ·761	·266
" 13,	± ·000	11 06 ·110	11 06 ·627	— ·217	31 ·250	— 6 ·78	— 2 ·006	·296
" 15,	+ ·010	11 06 ·320	11 06 ·787	— ·467	31 ·375	— 14 ·65	— 3 ·963	·271
May 10,	— ·270	11 10 ·220	11 10 ·526	— ·306	31 ·032	— 9 ·50	— 1 ·785	·188
" 12,	— ·119	10 57 ·781	10 58 ·001	— ·220	31 ·776	— 6 ·99	— 1 ·772	·253
" 13,	+ ·090	11 15 ·690	11 15 ·100	+ ·590	31 ·021	+ 18 ·30	+ 3 ·434	·188
June 7,	— ·010	11 05 ·530	11 06 ·010	— ·480	31 ·273	— 15 ·01	— 2 ·771	·185

YEAR AND DAY.	B	I'	I_o	e	n	ne	$hh \times ne$	hh
	s	m s	m s	s		s	s	
1840, June 8,	+·180	10 58·860	10 59·058	—·198	31·688	— 6·27	—1·129	·180
August 6,	+·005	12 53·255	12 54·092	—·837	27·066	—22·63	—7·441	·329
Septem. 6,	—·001	13 08·616	13 08·765	—·149	26·476	— 3·94	—1·620	·411
" 8,	—·190	12 18·470	12 18·858	—·388	28·168	—10·93	—2·385	·218
October 6,	+·020	11 59·640	11 59·754	—·114	28·943	— 3·29	—1·096	·333
" 7,	+·047	11 48·857	11 48·888	—·031	29·412	— 0·91	—0·275	·302
" 8,	+·330	11 52·460	11 51·991	+·469	29·368	+13·87	+2·783	·202
December 7,	—·240	16 25·310	16 24·857	+·453	21·351	+ 9·67	+3·738	·386
" 8,	—·212	17 19·958	17 19·829	+·129	20·135	+ 2·60	+1·851	·713
1841. January 2,	+·019	13 49·559	13 49·792	—·233	25·391	— 5·92	—2·633	·445
" 4,	—·225	16 34·415	16 34·724	—·309	21·125	— 6·53	—3·333	·510
February 2,	—·212	16 47·838	16 48·007	—·169	20·713	— 3·50	—2·357	·673
" 3,	—·040	16 22·940	16 23·257	—·317	21·147	— 6·70	—4·053	·605
" 4,	—·300	15 25·180	15 25·340	—·160	22·413	— 3·58	—1·711	·477
" 5,	—·035	14 16·435	14 16·251	+·184	24·184	+ 4·45	+1·831	·412
March 3,	—·208	15 21·132	15 21·368	—·236	22·545	— 5·32	—2·818	·530
April 1,	—·118	13 27·192	13 27·312	—·120	25·716	— 3·09	—1·288	·417
" 5,	+·080	12 18·330	12 18·490	—·160	28·317	— 4·53	—1·530	·338
May 1,	+·070	11 57·940	11 58·182	—·242	29·939	— 7·24	—1·309	·181
" 28,	—·090	11 57·160	11 57·539	—·379	29·039	—11·00	—2·355	·214
June 2,	—·097	13 20·673	13 20·805	—·132	36·138	— 1·36	—1·563	·453
" 28,	+·010	12 41·700	12 42·000	—·300	27·489	— 8·25	—2·626	·318
July 1,	+·090	13 30·103	13 29·872	+·231	25·760	+ 5·95	+2·428	·408
" 28,	+·030	13 28·730	13 28·842	—·112	25·812	— 2·89	—1·174	·406
" 29,	—·073	13 19·597	13 19·669	—·072	26·059	— 1·87	—0·703	·375
August 29,	+·264	11 28·934	11 28·660	+·274	30·204	+ 8·28	+2·001	·242
" 30,	—·255	11 05·525	11 05·851	—·326	31·277	—10·20	—3·010	·295
Septem. 26,	—·156	11 13·494	11 13·703	—·209	30·901	— 6·46	—2·034	·315
" 27,	+·103	10 59·543	10 59·936	—·393	31·603	—12·42	—3·367	·271
October 24,	+·089	11 00·979	11 00·485	—·494	31·548	—15·59	—2·479	·159
" 25,	+·143	10 56·053	10 55·921	+·132	31·841	+ 4·20	+1·197	·285
1842. January 22,	—·143	15 38·087	15 38·413	—·326	22·372	— 7·29	—3·133	·430
" 23,	—·280	16 19·450	16 19·762	—·312	21·359	— 6·66	—3·954	·593
" 24,	—·380	16 20·950	16 20·714	+·236	21·234	+ 5·01	+2·675	·534
February 22,	—·175	15 09·505	15 09·339	+·226	22·852	+ 5·17	+2·855	·553
" 23,	—·177	14 29·213	14 29·615	—·412	23·908	— 9·85	—4·977	·505
" 24,	—·247	13 51·273	13 54·523	—·250	24·936	— 6·23	—2·713	·435
March 20,	—·165	15 12·895	15 13·393	—·498	22·828	—11·37	—5·249	·462
April 21,	—·183	13 05·707	13 05·626	+·081	26·582	+ 2·15	+0·833	·387
" 22,	—·225	13 15·285	13 15·378	—·093	26·300	— 2·45	—1·052	·430
" 23,	—·065	13 37·785	13 38·117	—·332	25·592	— 8·50	—2·365	·278
June 18,	—·265	13 42·445	13 42·508	—·053	25·474	— 1·35	—0·485	·359

Sixty-nine corresponding observations of the *first* limb, the mean resulting correction from which, by weight, is

$$-5^s.05.$$

WASHINGTON AND HAMBURG.

Moon's second limb.

YEAR AND DAY.	B	I'	I_o	e	n	ne	$hh \times ne$	hh
	s	m s	m s	s		s	s	
1839, March 1,	—·020	10 25·590	10 25·609	—·019	33·352	— 0·63	—0·151	·238
" 30,	+·067	10 39·967	10 39·988	—·021	32·724	— 0·69	—0·151	·220

YEAR AND DAY.	B	I'	I_0	e	n	ne	$hh \times ne$	hh
	s	m s	m s	s		s	s	
1839. March 31,	— ·122	11 08 ·358	11 08 ·278	+ ·080	31 ·392	+ 2 ·51	+ 0 ·621	·247
October 22,	— ·170	14 43 ·510	14 43 ·912	— ·402	23 ·775	— 9 ·56	— 3 ·052	·319
1840, January 25,	— 330	11 22 ·090	11 22 ·667	— ·577	30 ·697	—17 ·71	— 3 ·255	·184
April 16,	— ·025	11 27 ·815	11 27 ·944	— ·129	30 ·455	— 3 ·93	— 1 ·004	·256
May 16,	+ ·042	12 52 ·812	12 52 ·916	— ·104	27 ·114	— 2 ·82	— 1 ·099	·390
Septem. 11,	— ·029	12 53 ·071	12 53 ·129	— ·058	29 ·328	— 1 ·70	— 0 ·564	·331
Novem. 12,	— ·130	16 25 ·470	16 25 ·867	— ·397	21 ·062	— 8 ·36	— 5 ·102	·610
" 13,	— ·100	15 14 ·620	15 14 ·780	— ·160	22 640	— 3 ·62	— 1 ·276	·352
1842, March 26,	— ·227	13 37 ·063	13 37 ·330	— ·267	27 011	— 7 ·21	— 2 ·675	·371
April 25,	+ ·095	14 33 ·445	14 33 ·589	— ·144	23 ·950	— 3 ·45	— 1 ·405	·407

Twelve corresponding observations of the *second* limb, the mean resulting correction from which, by weight, is

$$-4^s.87.$$

Eighty-one corresponding observations of both limbs, giving a mean correction, by weight, of

$$-5^s.03.$$

RECAPITULATION OF FINAL RESULTS.

	FIRST LIMB.			SECOND LIMB.		
	No. of Obsns.	$[hh]$	$[hh \times ne]$	No. of Obsns.	$[hh]$	$[hh \times ne]$
			s			s
Edinburgh, - -	64	14727	— 10 9693	23	05470	— 0 3804
Oxford, - -	32	08564	6·6934	13	03831	1·0635
Greenwich, - -	60	15287	5·7258	41	11192	3·7802
Cambridge, - -	57	16258	2 4613	23	07836	5·4551
Hamburg, - -	69	25639	12·8783	12	03925	1 9113
Sums, - -	282	80175	38·7281	112	32254	13 0905
$\frac{[hh \times ne]}{[hh]}$		$-4^s.81.$			$-4^s.06.$	

And the error in the assumed longitude derived from the three hundred and ninety-four comparisons is

$$-4^s.60,$$

or the old naval observatory on Capitol hill, was in longitude $5^h\ 08^m\ 00^s.0$ West of Greenwich.

ARTICLE XIV.

On the Accuracy of the Tabular Longitude of the Moon, to be obtained by the construction of New Lunar Tables. By Miers Fisher Longstreth. Read January 3, 1851.

The discovery of the inequalities of a long period, by Hansen, together with the reduction of the Greenwich Lunar Observations from 1750 to 1830, afford ample materials for the construction of new lunar tables, and lead to the inquiry, what additional accuracy can be obtained. The co-efficients deduced from theory by Damoiseau, Plana, Pontecoulant, and those deduced from observation by Burckhardt, (though differing considerably,) give the moon's place with *nearly* the same accuracy. Where a difference exists, I have carefully compared them with observation and deduced the most probable value. To test the accuracy of the new co-efficients thus obtained, I have selected from the "Reduction of Greenwich Lunar Observations" all the observations made during the years 1820, '21, '23, '24, and '25, numbering 499, and have computed the moon's place with the new co-efficients, by correcting Plana's, when necessary; they having been used in the Reduction of Greenwich Lunar Observations to obtain the moon's tabular place. In the following pages I have arranged for comparison the errors of Plana's co-efficients and those of the new co-efficients, to which have been added the corrections for Hansen's inequalities, and most of the corrections required by Plana's theory deduced by G. B. Airy. Upon examination, it will be found that in many cases where the errors of the new co-efficients are large, that the observations have been made while the sun was above the horizon, or during twilight. The errors here given are necessarily compounded of the errors of the tabular place and of those of observation. It will be well to inquire what amount of error of observation is liable to be made, and for this purpose I have selected from the Greenwich Lunar Reductions the following clock errors, obtained by transits of stars differing little in right ascension, and observed by the same person, therefore free from what is generally termed "personal error."

	By transit of	Clock slow	Difference.
1820. March 6.	Procyon.	— 7.77	
	Pollux.	— 8.00	.23^s=3″.4
Aug. 24.	γ Aquilæ.	— 1.03	
	α Aquilæ.	— 3.83	.20^s=3″.0
1821. Feb. 15.	Procyon.	+23.26	
	Pollux.	+25.59	.33^s=5″.0

	By transit of	Clock slow.	Difference.
Sept. 14.	γ Aquilæ.	+ 5.99	
	β Aquilæ	+ 5.65	$.34^s = 5''.1$
1824. Oct. 13.	Procyon.	— 7.63	
	Pollux.	— 7.38	$.25^s = 3''.7$
1825. July 2.	α^1 Capricorni.	—47.70	
	α^2 Capricorni.	—47.50	$.20^s = 3''.0$
Aug. 31.	γ Aquilæ.	—51.13	
	α Aquilæ.	—51.44	$.31^s = 4''.6$
Dec. 25.	Procyon.	— 4.21	
	Pollux.	— 4.60	$.41^s = 6''.1$

I have also selected from the same work, some observations where both limbs of the moon have been observed, and should show the same tabular error.

	Tab. error by 1st limb.	Tab. error by 2d limb.	Difference.
1823. Oct. 19.	+ 1″.2	+ 6″.5	5″.3
1825. May 31.	— 0 .1	— 4 .4	4 .3
June 29.	— 1 .2	— 4 .3	3 .1
July 29.	— 2 .6	— 5 .8	3 .2

Now should an error of observation be made at the time of the maximum tabular error, both with the same sign (and it is as liable to be made at this time as at any other,) the apparent tabular error will be greater than the real error by the amount of the error of observation, which I have shown often amounts to from 3″ to 6″. In the following list there are comparatively few errors amounting to over 10″ when the observations have been made under favourable circumstances, and it is but reasonable to suppose that the excess over 10″ is due to the error of observation; and if we reject all observations made while the sun is above the horizon, and the observations of November 12, 1821, and of January 24, 1823, (which are doubtless erroneous,) and allow for possible error of observation as here shown, there is no error that will exceed 7″.5 or a half second of time.

Damoiseau, in his Tables de la Lune, 1824, has given the errors of his tables with fifty observations made at Greenwich, together with those of Burg and Burckhardt. I have also computed the moon's place for the same observations, and included the errors in the following list; together with those of Burg, Burckhardt, Damoiseau, and Plana for comparison. The errors stated in the Tables de la Lune being modified according to the alteration made in the moon's R. A. in the Reduction of the Greenwich Lunar Observations.

Philadelphia, First month 3rd, 1851.

Date of Observation	Errors of Plana's Co-efficients	Errors of New Co-efficients	Remarks.
1820.			
Jan. 1	— 5″.2	— 2″.5	
3	— 5 .9	— 5 .3	
4	— 3 .3	— 2 .7	
5	— 8 .7	— 6 .7	
22	— 1 .2	+ 1 .4	
23	+ 1 .2	+ 4 .0	
24	+ 2 .4	+ 1 .5	
27	+ 9 .0	+ 2 .5	
31	— 0 .6	— 6 .6	Moon's limb tremulous.
Feb. 1	+ 7 .6	+ 0 .6	
4	— 3 .6	— 2 .9	
8	—16 .9	—10 .9	Sun above the horizon.
22	+ 6 .6	+ 1 .7	
26	+ 7 .9	+ 2 .3	
27	+ 0 .9	— 5 .1	
28	+ 3 .2	— 5 .4	
Mar. 3	+ 1 .3	— 4 .9	
4	+ 2 .7	— 0 .3	
6	— 3 .2	— 3 .0	
8	—15 .5	—13 .8	Sun above the horizon.
20	+ 9 .4	+ 3 .6	
23	+ 9 .1	— 0 .3	
24	+ 2 .1	+ 2 .5	
25	+ 5 .5	+ 1 .3	
29	+ 0 .5	— 6 .9	
30	+ 3 .7	— 4 .1	
31	— 1 .5	— 5 .6	
April 3	— 6 .6	— 6 .5	
6	+ 1 .0	— 3 .1	
18	+ 5 .8	+ 0 .6	
19	+10 .1	+ 2 .4	
20	+13 .6	+ 2 .7	
21	+10 .6	+ 1 .7	
22	+11 .2	+ 4 .6	
23	+ 5 .6	+ 4 .0	
24	+ 3 .1	+ 4 .4	
25	— 0 .9	+ 1 .4	
28	—11 .5	— 9 .9	
29	— 6 .9	— 2 .6	
30	—13 .1	— 6 .7	
May 1	—12 .9	— 7 .1	
4	+ 5 .1	— 3 .4	
5	+11 .9	+ 2 .4	
19	+ 9 .0	+ 1 .1	
20	+14 .7	+ 6 .8	
21	+ 9 .7	+ 3 .0	
22	+11 .7	+ 7 .2	
23	+ 3 .9	+ 0 .2	
25	+ 4 .9	+ 1 .4	
29	—13 .5	— 1 .4	
30	—14 .9	— 4 .2	
31	— 6 .0	— 0 .6	
June 4	+12 .2	+ 3 .4	
19	+ 8 .7	+ 4 .5	
21	+ 7 .6	+ 1 .5	
23	+ 9 .1	+ 0 .7	
24	+ 7 .6	+ 1 .5	
25	+ 3 .1	+ 1 .5	
June 26	+ 0″.1	+ 3″.4	
27	— 6 .9	— 0 .7	
July 1	— 5 .7	— 5 .7	This observation is marked defective in the Greenwich Observations.
2	—12 .5	—12 .8	
19	+ 5 .6	+ 3 .8	
21	+ 9 .1	+ 4 .2	
27	+ 5 .6	+ 1 .9	
29	+ 0 .7	— 5 .2	
30	— 3 .3	— 6 .9	
Aug. 1	+ 1 .9	— 1 .2	
17	+12 .5	+ 9 .3	Sun above the horizon.
19	+ 4 .0	+ 2 .4	
20	+ 3 .3	+ 2 .9	
24	+ 9 .3	+ 3 .8	
26	+13 .0	+ 1 .2	
28	+10 .2	+ 0 .2	
29	+ 6 .9	— 0 .6	
30	+ 0 .8	— 5 .6	
31	— 1 .5	— 8 .0	
Sep. 1	+ 8 .4	— 3 .6	
18	+ 6 .7	+ 6 .9	
19	+ 9 .2	+10 .4	
21	+ 4 .8	+ 2 .1	
22	+15 .1	+ 9 .6	
25	+14 .1	+ 3 .1	
26	+16 .2	+ 4 .9	
27	+ 7 .4	— 3 .8	
Oct. 16	+10 .3	+ 5 .7	
17	+ 4 .5	+ 1 .5	
21	+10 .4	+ 3 .4	
22	+ 0 .7	— 6 .3	
23	+10 .0	+ 3 .2	
25	+ 3 .8	— 4 .4	
26	+11 .2	+ 1 .7	
29	+ 5 .7	— 5 .2	
Nov. 13	+10 .7	+ 5 .8	
15	+ 3 .2	0 .0	
16	+ 7 .5	+ 2 .1	
18	+ 9 .7	0 .0	
19	+ 5 .8	— 1 .3	
23	+ 1 .2	— 3 .1	
25	+ 0 .7	— 5 .7	
26	+ 3 .0	— 3 .5	
Dec. 12	+ 0 .9	— 1 .6	
14	+ 1 .4	+ 1 .1	
21	— 8 .5	— 8 .7	
1821.			
Jan. 12	+ 2 .9	+ 1 .1	
14	+ 8 .1	+ 0 .5	
16	+ 1 .5	— 2 .1	
20	— 9 .6	—11 .2	Foggy.
28	— 7 .1	— 3 .9	
Feb. 8	+ 0 .3	+ 0 .2	
9	+ 6 .1	+ 5 .6	
10	+ 3 .1	+ 0 .4	
11	+ 6 .3	+ 0 .1	
13	+ 2 .2	— 6 .1	
15	— 0 .1	— 3 .8	
19	— 5 .6	— 9 .2	Moon's limb tremulous.

Date of Observation.	Errors of Plana's Co-Efficients.	Errors of New Co-Efficients.	Remarks.
Feb. 21	— 9″.3	— 5″.3	No star observed within 4 hours.
22	—20 .9	—11 .9	
23	—19 .6	—11 .0	No star observed within 7 hours.
26	—16 .8	—10 .5	
Mar. 10	+ 3 .8	+ 3 .0	
11	+ 6 .8	+ 1 .9	
12	+ 1 .7	— 2 .9	
13	+ 3 .7	— 2 .0	
14	+ 6 .6	+ 0 .9	
15	+ 0 .1	— 4 .0	
16	+ 1 .1	— 3 .5	
22	— 7 .4	— 5 .8	Moon's limb very tremulous.
25	— 8 .8	— 6 .3	
April 8	+ 5 .8	+ 3 .0	
9	+ 4 .1	+ 1 .7	
10	+ 3 .9	+ 2 .6	
12	+ 1 .3	+ 2 .7	
13	— 7 .0	— 5 .6	
14	— 9 .0	— 7 .6	
15	— 3 .2	— 5 .1	
16	— 1 .0	— 9 .6	
17	— 4 .8	—12 .0	Clock rate very irregular.
24	+ 2 .0	— 1 .4	
25	+ 3 .0	+ 4 .3	
May 9	— 1 .8	— 3 .0	
10	— 1 .5	— 0 .9	
12	— 8 .3	— 2 .3	
13	— 9 .5	— 3 .2	
14	— 7 .8	— 1 .9	
15	— 7 .0	— 1 .9	
16	— 3 .2	+ 2 .2	
18	—10 .4	— 2 .9	
20	— 6 .1	— 5 .4	
21	— 1 .3	— 5 .3	
23	+10 .5	+ 3 .0	
June 7	— 0 .3	— 1 .1	Sun above the horizon, and no star observed this day.
9	—11 .2	—14 .1	
14	— 6 .9	+ 3 .9	
18	— 5 .0	+ 3 .1	
21	— 1 .9	— 6 .6	
July 10	+ 5 .5	+ 1 .0	
12	— 4 .0	— 2 .9	
13	— 7 .3	— 2 .4	
14	— 5 .9	+ 1 .9	
16	—16 .4	— 7 .1	Very cloudy.
17	— 3 .6	+ 4 .3	
18	— 4 .5	+ 2 .2	
20	— 7 .5	— 5 .5	
22	+ 6 .4	+ 0 .4	
Aug. 4	— 9 .4	— 4 .9	
5	+ 0 .9	+ 3 .1	
9	+ 1 .3	+ 1 .8	
10	+ 1 .4	— 0 .1	
11	+ 1 .5	— 0 .8	
12	+ 3 .7	+ 0 .8	
14	+10 .6	+ 7 .1	
15	— 1 .3	— 3 .5	
16	— 3 .7	— 4 .5	
19	— 6 .2	— 5 .7	
Aug. 20	— 0″.5	— 2″.8	
Sept. 5	+ 1 .2	— 3 .9	
6	+ 5 .4	+ 3 .7	
7	+ 3 .1	+ 2 .9	
8	+ 3 .6	+ 3 .1	
12	+ 4 .1	— 7 .9	
14	+ 3 .4	— 4 .9	
17	+ 3 .8	— 1 .3	
18	— 3 .5	+ 0 .1	
Oct. 2	+ 1 .4	— 9 .5	
5	+ 8 .6	+ 6 .5	
8	+ 7 .1	+ 3 .6	
9	+ 5 .7	— 1 .9	
10	+ 7 .8	— 2 .7	
13	+ 8 .3	— 0 .5	
15	+15 .9	+ 4 .8	
31	+ 8 .1	+ 3 .0	
Nov. 4	+ 6 .0	+ 2 .3	
5	+ 5 .9	+ 1 .9	
6	+ 6 .6	+ 0 .1	
7	+10 .9	+ 1 .6	
8	+12 .6	+ 3 .3	
9	+ 4 .4	— 2 .8	Defective, and no star observed within six hours.
12	—11 .2	—19 .1	
15	+ 9 .5	— 1 .6	
16	+ 3 .2	— 4 .8	
30	+ 6 .3	— 3 .9	
Dec. 1	+11 .2	+ 1 .2	
2	+ 6 .0	— 2 .3	
5	+15 .6	+ 6 .0	
6	+16 .0	+ 5 .2	
8	+ 4 .7	+ 0 .1	
11	+ 1 .9	— 4 .1	
12	+ 6 .9	— 2 .5	
13	+ 7 .0	— 1 .1	
14	— 2 .8	— 9 .9	
15	+ 4 .0	— 2 .2	
31	+ 9 .0	+ 1 .5	
1823.			
Jan. 3	+ 5 .9	— 1 .7	
19	+ 7 .0	+ 2 .0	
23	+11 .1	+ 9 .3	Defective.
24	—19 .6	—21 .2	No star obs'd this day.
Feb. 3	+ 5 .8	— 6 .8	
4	+ 3 .5	— 9.9	Moon's limb tremulous.
19	+12 .2	+ 4 .1	
20	+ 5 .9	— 0 .6	
21	+ 3 .3	— 2 .3	
22	+ 4 .4	— 1 .8	
23	+ 8 .5	+ 1 .4	
24	+ 5 .6	— 2 .8	
25	+ 5 .1	— 3 .9	
26	+ 5 .5	— 3 .3	
27	+ 2 .3	— 5 .3	
March 1	+ 1 .4	— 2 .7	
19	+16 .3	+ 5 .4	
20	+15 .3	+ 5 .5	Hazy.
21	+15 .8	+ 5 .7	
23	+13 7.	— 0 .5	

Date of Observation	Errors of Plana's Co-efficients.	Errors of New Co efficients.	Remarks.
Mar. 27	+ 7″.4	— 1″.6	
30	— 8 .4	—10 .9	
April 18	+11 .9	+ 5 .7	
19	+10 .5	+ 1 .4	
20	+18 .2	+ 3 .5	
21	+21 .0	+ 0 .6	
22	+24 .4	+ 1 .0	
24	+28 .6	+ 9 .7	
27	+ 3 .7	— 4 .8	
28	+ 2 .2	— 4 .1	
29	— 0 .5	— 5 .1	
30	— 7 .3	—10 .1	Sun in the horizon.
May 1	0 .0	— 1 .1	
16	+ 3 .4	+ 2 .3	
17	+ 4 .6	+ 3 .1	
18	+ 2 .9	— 1 .8	
19	+12 .2	+ 2 .1	
23	+12 .2	— 6 .3	
27	+ 8 .1	— 4 .9	
28	+ 4 .2	— 3 .6	
29	+ 1 .8	— 3 .6	
30	+ 2 .7	+ 1 .4	
31	— 1 .2	— 0 .3	
June 1	— 3 .7	— 2 .6	
15	— 0 .5	— 1 .4	
16	— 6 .3	— 8 .0	Sun above the horizon.
17	+ 1 .3	— 3 .8	
20	+ 2 .5	— 4 .5	
23	— 0 .6	— 8 .4	
24	+ 5 .0	— 5 .5	
28	+ 1 .8	— 0 .2	
29	— 3 .3	— 4 .2	
July 21	—10 .0	+ 0 .1	
29	+ 0 .4	— 3 .0	
Aug. 14	+ 7 .7	+ 0 .8	
15	+ 7 .4	+ 2 .6	
16	— 2 .9	— 2 .8	
18	— 6 .4	+ 5 .6	
19	—14 .0	— 0 .5	
21	—14 .6	— 1 .8	Both limbs observed.
21	—14 .7	— 1 .9	
22	—12 .9	+ 1 .0	
26	—10 .1	— 5 .5	
28	+ 0 .7	— 4 .3	
Sep. 11	+ 6 .2	+ 2 .1	
12	+ 5 .9	+ 0 .8	
13	+ 7 .3	+ 3 .4	
14	+ 0 .8	— 0 .5	
15	— 1 .9	+ 0 .3	
16	— 4 .6	0 .0	
17	— 6 .5	— 0 .4	
18	— 8 .2	— 1 .6	
19	— 8 .8	— 0 .4	
20	—11 .6	+ 0 .3	
22	—17 .1	0 .0	No star obs'd for more than 6h previous and none afterwards.
24	—19 .3	—11 .7	
26	— 8 .3	— 9 .3	
Oct. 12	— 1 .1	— 0 .3	
13	+ 1 .8	+ 3 .3	

Date of Observation.	Errors of Plana's Co-Efficients.	Errors of New Co-Efficients.	Remarks.
Oct. 14	— 0″.1	+ 1″.3	
15	+ 2 .9	+ 4 .1	
16	+ 3 .9	+ 4 .5	
19	— 6 .0	— 0 .8	Both limbs observed.
19	— 0 .7	+ 4 .5	
22	— 5 .9	+ 0 .7	
23	— 6 .8	— 3 .2	
24	— 6 .0	— 4 .4	
Nov. 10	— 8 .3	— 2 .8	
12	— 0 .3	+ 1 .1	
13	+ 2 .9	+ 5 .6	
16	+ 1 .1	+ 5 .6	
19	— 8 .1	— 8 .4	Cloudy.
20	+ 0 .5	+ 0 .7	
Dec. 9	— 9 .5	— 0 .2	
10	— 9 .8	— 1 .4	
12	— 1 .9	+ 4 .4	
13	— 0 .2	+ 5 .8	
14	— 2 .7	+ 3 .2	
15	— 3 .0	+ 1 .9	
18	— 0 .2	— 2 .6	
19	— 0 .9	— 6 .1	
20	+ 2 .6	— 4 .0	
22	+ 4 .0	+ 0 .1	
25	+ 2 .0	— 0 .5	
1824.			
Jan. 8	— 7 .3	— 1 .0	
11	— 8 .6	— 2 .5	
12	— 3 .2	+ 2 .9	
13	+ 1 .6	+ 7 .3	
18	+ 6 .3	— 3 .8	
22	— 1 .9	— 7 .7	
23	— 2 .1	— 8 .5	
Feb. 9	— 5 .9	— 3 .2	
10	— 7 .2	— 1 .9	
11	— 0 .6	+ 0 .2	
12	+10 .7	+ 6 .9	
15	+15 .1	+ 5 .4	
18	+ 0 .6	— 8 .0	
Mar. 8	+ 7 .7	+ 0 .7	
9	+ 0 .5	— 3 .5	
12	+10 .6	— 3 .5	
13	+19 .3	+ 9 .8	
14	+14 .5	+ 6 .1	
16	+ 4 .1	+ 0 .1	
19	— 0 .8	— 8 .0	
April 9	+20 .6	+ 7 .0	
11	+12 .5	+ 6 .9	
12	+10 .3	+ 3 .6	
13	+ 1 .8	— 2 .6	
14	— 2 .9	— 1 .9	
17	— 5 .9	— 9 .9	No stars obs'd within 5 hours.
18	— 2 .8	— 6 .3	
19	— 2 .6	— 1 .7	
20	— 1 .6	— 3 .0	
May 9	+24 .3	+ 0 .8	
10	+19 .5	— 2 .4	
16	— 5 .5	— 9 .9	Obs. made 18m before sun-rise.
June 6	+21 .1	+ 2 .8	

Date of Observation.	Errors of Plana's Co-Efficients.	Errors of New Co-Efficients.	Remarks.
June 7	+22″.9	+ 1″.2	
8	+23 .6	+ 1 .3	
11	+ 8 .9	— 6 .8	
12	+ 9 .2	— 6 .3	
15	+ 0 .2	— 3 .3	
July 7	+16 .1	+ 5 .6	
8	+ 8 .0	— 1 .5	
11	+ 7 .5	+ 5 .3	
12	+ 7 .9	— 6 .1	
13	+ 7 .3	— 3 .3	
15	— 4 .2	— 5 .4	
16	— 6 .4	— 6 .7	
Aug. 5	— 2 .4	+ 0 .5	
7	— 3 .2	+ 0 .7	
9	— 3 .2	— 4 .1	Both limbs observed.
9	— 1 .6	— 2 .5	Both limbs observed.
11	— 0 .5	— 2 .0	
12	— 1 .5	— 1 .2	
13	— 2 .0	— 2 .1	
15	+ 3 .0	— 3 .2	
18	+ 3 .0	— 1 .7	
31	+ 8 .0	+ 1 .2	
Sept. 1	— 1 .3	— 4 .6	
2	— 4 .0	— 3 .2	
4	—12 .7	— 5 .5	
5	—16 .9	— 8 .0	
6	—14 .8	— 5 .7	
8	—17 .5	— 8 .0	Both limbs observed.
8	—16 .2	— 6 .7	Both limbs observed.
12	+ 1 .9	+ 1 .8	
13	+ 2 .7	— 3 .5	
15	+ 4 .7	— 4 .6	
29	— 0 .8	— 6 .9	
Oct. 1	— 1 .0	— 3 .2	
2	— 3 .7	— 4 .6	
3	— 3 .9	— 3 .6	
8	— 9 .9	+ 1 .3	
10	— 5 .8	+ 1 .3	
11	— 4 .3	— 1 .8	
12	— 2 .1	— 4 .6	
13	— 0 .9	— 6 .3	
14	+ 1 .4	— 5 .0	
15	+ 0 .1	— 6 .2	
29	— 2 .0	— 2 .9	
Nov. 2	+ 6 .7	+ 2 .9	
3	+ 1 .7	+ 0 .4	
5	— 6 .4	— 2 .5	
7	— 0 .2	+ 4 .0	
11	+ 1 .7	— 1 .1	
14	+ 0 .6	— 3 .9	
15	+ 1 .7	— 4 .9	
Dec. 1	— 0 .6	— 2 .7	
3	+ 0 .5	+ 2 .2	
5	+ 1 .2	+ 0 .7	
7	+ 7 .1	+ 3 .3	
8	+ 8 .7	+ 4 .9	
10	— 1 .4	— 3 .0	
11	— 2 .3	— 3 .2	
26	— 6 .7	+ 2 .5	
Dec. 29	0″.0	+ 1″.3	
30	0 .0	+ 2 .6	
31	— 2 .9	+ 0 .9	
1825.			
Jan. 2	— 2 .2	— 1 .4	
4	+ 1 .6	— 3 .9	
4	+ 3 .5	— 2 .0	
5	+ 3 .2	— 2 .7	
7	— 0 .5	— 2 .6	
8	— 2 .5	— 3 .4	
11	— 5 .2	— 6 .0	
24	— 8 .8	— 4 .9	
25	— 5 .6	+ 1 .1	
28	— 2 .2	+ 3 .3	
29	— 5 .1	+ 0 .9	
Feb. 1	+ 9 .5	+ 4 .2	
2	+18 .0	+10 .5	No star obs'd this day.
3	+ 4 .1	— 2 .5	
4	— 1 .4	— 5 .0	Cloudy.
May 28	+14 .5	+ 5 .6	Clock rate very irregular.
30	+ 3 .1	— 0 .2	
31	+ 2 .6	+ 1 .6	Both limbs observed.
31	— 1 .6	— 2 .7	Both limbs observed.
June 2	— 2 .4	— 4 .7	
4	— 4 .3	— 4 .8	
6	— 6 .2	— 4 .2	
25	+16 .7	+ 3 .0	
27	+11 .5	— 2 .6	
28	+10 .6	— 2 .7	
29	+10 .0	— 1 .9	Both limbs observed.
29	+ 6 .9	— 5 .0	Both limbs observed.
July 2	+ 1 .9	— 4 .5	
3	— 2 .0	— 4 .1	
24	+ 8 .5	+ 3 .2	
26	+11 .3	+ 0 .5	
27	+11 .0	— 2 .3	
28	+10 .1	— 4 .8	
29	+11 .4	— 4 .4	Both limbs observed.
29	+ 8 .2	— 7 .6	Both limbs observed.
30	+ 6 .3	— 8 .6	
31	+ 6 .4	— 5 .5	
Aug. 1	+ 3 .5	— 4 .6	
2	+ 0 .8	— 5 .1	
4	+ 0 .6	— 0 .2	
5	+ 1 .4	— 3 .2	
6	+ 1 .8	— 3 .2	
7	+ 1 .5	— 2 .3	
23	+ 0 .6	+ 1 .9	
24	+ 0 .7	— 0 .7	
25	+ 4 .8	+ 0 .1	
26	+ 6 .4	+ 0 .2	
30	+ 6 .9	+ 1 .4	
31	+ 4 .3	— 1 .3	
Sept. 19	— 1 .8	— 4 .7	
20	— 5 .7	— 5 .5	
21	— 6 .6	— 5 .8	
22	— 4 .0	— 4 .1	
26	— 3 .8	+ 0 .7	
27	— 5 .4	— 1 .7	

Date of Observations.	Errors of Plana's Co-Efficients.	Errors of New Co-Efficients.	Remarks.	Date of Observations.	Errors of Plana's Co Efficients.	Errors of New Co-Efficients	Remarks.
Sept. 28	—.2″.5	— 1″.1		Nov. 24	— 3″.1	— 3″.6	
29	+ 0 .4	— 2 .3		25	+ 3 .5	+ 0 .2	
Oct. 2	+ 6 .6	— 0 .6		26	+ 3 .2	— 1 .5	
3	+ 1 .1	— 6 .8		Dec. 14	+ 5 .7	— 0 .9	
21	+ 5 .0	— 2 .6		15	+ 7 .7	+ 1 .7	
22	+ 2 .1	— 3 .9		16	+ 7 .8	+ 0 .6	
24	— 6 .8	— 3 .9		17	+10 .0	+ 0 .5	
25	— 5 .2	+ 0 .4		18	+15 .9	+ 4 .5	
26	— 7 .3	— 2 .2	Both limbs observed.	19	+ 8 .2	— 2 .1	
26	— 4 .4	+ 0 .7		20	+10 .3	+ 3 .5	
29	0 .0	+ 3 .7		22	+ 6 .5	+ 3 .4	
30	— 2 .8	— 6 .2	Obs. made 36^{m} before sunrise.	23	+ 7 .0	+ 2 .0	
Nov. 3	— 4 .4	—10 .6		24	+ 6 .6	— 0 .3	
15	+12 .1	+ 1 .7		25	+10 .1	+ 2 .2	
19	+10 .8	— 2 .1		26	+ 9 .0	+ 3 .4	
21	+ 4 .5	— 2 .7		27	+ 4 .5	+ 1 .8	
22	— 0 .7	— 2 .8					

Date of Observation.	Errors of Burg's Co-Efficients.	Errors of Burckhardt's Co-Efficients.	Errors of Damoiseau's Co-Efficients.	Errors of Plana's Co-Efficients.	Errors of New Co-Efficients.
1802. January 18				+ 2″.5	+ 3″.4
18	+ 2″.4	+ 3″.5	— 2″.3	+ 1 .7	+ 2 .3
19	+ 1 .1	— 6 .6	— 6 .5	+ 0 .8	+ 0 .5
22	+ 2 .9	— 1 .5	+ 6 .9	+ 1 .6	+ 0 .8
February 13	— 5 .5	+ 0 .1	— 7 .5	+ 1 .2	— 3 .7
15	— 0 .9	— 4 .3	+ 0 .4	— 4 .1	— 5 .4
16	— 0 .7	— 3 .2	— 2 .1	— 6 .6	— 8 .7
March 13	—13 .3	— 4 .4	—17 .6	+ 9 .2	+ 3 .1
14	— 2 .9	— 4 .7	— 5 .2	+ 1 .5	— 1 .9
15	—10 .2	—10 .3	— 8 .3	+ 0 .4	+ 0 .2
16	+ 3 .3	+ 6 .8	+ 9 .0	— 6 .6	— 4 .9
17	+ 5 .9	+ 6 .2	+ 6 .0	— 8 .0	— 7 .9
April 11	— 5 .3	—16 .2	—12 .2	+ 9 .3	+ 3 .2
12	— 5 .7	—15 .9	—12 .6	+ 6 .8	+ 4 .1
25	+ 9 .7	— 2 .2	+ 1 .0	+12 .7	+ 7 .3
May 8	+ 3 .7	— 4 .5	+ 1 .3	+ 0 .8	— 2 .0
9	+ 4 .2	— 6 .1	— 1 .9	+ 3 .5	— 0 .7
10	— 2 .1	—15 .3	—12 .1	+ 6 .8	+ 2 .6
11	+ 3 .9	— 8 .0	— 6 .0	+ 4 .2	+ 1 .4
21	+16 .8	+ 0 .2	+ 8 .7	— 4 .4	+ 1 .3
22	+ 9 .2	— 3 .3	+ 2 .8	+ 3 .5	+ 4 .3
23	+13 .5	— 0 .5	+ 5 .6	+ 4 .5	+ 2 .4
June 18	+ 9 .4	— 2 .0	+ 7 .1	— 3 .8	+ 3 .5
August 12	— 6 .4	+ 0 .2	+ 1 .1	— 4 .5	— 2 .8
13	— 0 .5	+10 .1	+ 9 .0	— 0 .6	— 1 .3
14	— 4 .8	+ 4 .1	— 1 .9	+ 1 .7	— 2 .0
15	— 1 .3	+ 6 .8	+ 3 .2	+ 7 .8	+ 1 .1
September 10	+ 1 .1	+ 9 .7	+ 3 .4	— 3 .4	— 0 .5
12	— 8 .9	— 3 .1	— 7 .7	+14 .6	—12 .1
October 9	+ 1 .7	+ 1 .6	—11 .2	+ 5 .5	+ 3 .0
10	+ 7 .7	+12 .8	+ 1 .5	+ 3 .3	0 .0
November 7	— 4 .7	+ 1 .1	—10 .3	+ 8 .4	+ 2 .2
December 2	— 5 .2	+ 2 .3	— 8 .4	— 1 .8	+ 0 .3
3	+ 7 .9	+12 .5	+ 7 .0	— 1 .5	+ 0 .8
4	+ 2 .0	+ 5 .0	+ 0 .9	— 3 .1	— 2 .4
14	— 6 .4	— 3 .1	— 6 .7	— 8 .6	— 4 .9
17	+ 2 .2	+ 3 .6	— 4 .3	—11 .2	— 5 .4
1803. January 11	— 1 .1	— 0 .8	— 1 .2	—10 .5	— 5 .0
February 9	+ 8 .3	+ 4 .7	+ 6 .3	— 3 .5	— 0 .2
10	— 0 .1	+ 6 .5	+ 6 .0	— 8 .5	— 3 .6
April 2	— 7 .0	— 0 .4	— 9 .3	—11 .5	— 6 .6
3	— 5 .1	— 2 .8	— 5 .5	—13 .6	— 8 .0
4	— 4 .9	— 6 .2	— 5 .2	— 6 .9	— 2 .6
5	+ 2 .3	+ 3 .0	+ 1 .8	— 8 .6	— 8 .6
May 3	— 6 .8	— 1 .6	— 6 .1	—10 .4	— 2 .5
4	— 2 .3	+ 3 .4	— 2 .8	—12 .6	— 5 .4
30	— 3 .3	— 8 .0	—11 .1	— 6 .5	— 2 .3
31	—10 .2	—10 .8	—12 .7	— 4 .1	+ 0 .8
June 27	+ 0 .3	— 1 .2	— 4 .9	— 8 .7	— 3 .9
28	— 0 .4	— 3 .0	— 7 .8	— 2 .9	— 0 .9
29	+ 4 .5	+ 2 .9	— 0 .2	— 5 .7	— 5 .2

ARTICLE XV.

On the Organization of the Genus Gregarina of Dufour. By Joseph Leidy, M. D. Read January 3, 1851.

In 1826, Dufour described in the *Annales des Sciences Naturelles*, an entozoic parasite found within the intestinal canal of various coleopterous insects. He gave a general account of its structure, and notices its apparent analogy to the genus of intestinal worms, *Caryophyllæus*, of Rudolphi, and also remarks, p. 45, that Ramdohr has represented the same animal under the name of "Petit sac de l'Epiploon," found in the *Dermestes lardarius*.

In 1828, Dufour, in the same work, characterized the parasite as a new and distinct genus of entozoa, under the name of *Gregarina*, "que exprime l'habitude qu' ont ces vers intestinaux de vivre en troupeaux." Those infesting Coleoptera, he designated under the general specific name of *Gregarina conica*, those found in the *Forficula*, he called *Gregarina ovata*. The author gives three figures of the latter, one of which represents an attached pair.

In 1838, Hammerschmidt indicated, in the *Isis von Oken*, a number of species of *Gregarina*, which, with very little reason, he subdivided into five genera.

Siebold, in 1829, Kölliker, in 1845, Henle, in the same year, Frantzius, in 1846, and Stein, in 1848, wrote upon the character of the *Gregarinæ;* but to their writings I have not been able to have access.

In 1848, Kölliker wrote a second time on the nature of *Gregarina*, in Siebold and Kölliker's *Zeitschrift fur Wissenschaftliche Zoologie*, vol. i., p. 1, in which he contends that this singular helminth is a single, simple organic cell,—an opinion he held in his former memoir, and which, according to this author, was questioned by Henle and Frantzius.

In the second part of the latter memoir of Kölliker, p. 18, on the general views of the nature of *Gregarinæ*, he asks "Sind die *Gregarinen* Thiere?" (are the *Gregarinæ* animals?) a question which arose from an opinion expressed by Henle, from their relationship to the receptacles of the *naviculæ*, which latter are usually considered as vegetable in their nature. In answer to the question, the author says, the contractility of the membrane and its solubility in acetic acid, speak pretty safely for the animal nature of the *Gregarinæ*, as no contractile cell membrane soluble in acetic acid is yet known among plants.*

* Loc. cit. p. 18. "Die Contractilität der Membran derselben und zweitens deren Auflöslichkeit in Essigsäure ziemlich sicher fur die thierische Natur dieser Wesen sprechen, da man bis jezt bei Pflanzen durchaus keine contractile und in Essigsäure lösliche Zellmembranen kennt."

Besides, observing that the peculiarity of the movements is more like that of animals than of plants, he finally states, that the habitation of the *Gregarinæ* is such as is frequent among lower animals, and but seldom among plants.

Without at all entering into the views of Henle, in considering the *Gregarinæ* of a vegetable nature, I must state in opposition to Kölliker, that contractility of cell membrane does exist in the vegetable kingdom, if the *Achlya prolifera* be regarded as a plant, for its spores after escaping from the sporangium do not only move by means of vibrillæ, but there is also a very evident degree of contractile movement existing in their membrane. In relation to the habitation of plants being but rare in animals, my observations lead me to consider the occurrence of plants growing within healthy living animals as by no means an unfrequent one.*

In answer to a second question proposed by the author, "Sind die *Gregarinen* einzellige Thiere?" (Are the *Gregarinæ* single-celled animals?), he regards the integument of these animals as cell membrane, the fluid and granular matter within as cell contents, and the clear corpuscle, among the latter, as a cell nucleus containing a nucleolus. This is the most important opinion as to the character of the parasite, and is the one most objected to by Henle and Frantzius, who contend that the interior corpuscle is not of the nature of a cell nucleus.

Kölliker appears to have been mostly influenced in forming an idea as to the nature of the *Gregarina*, from its close relationship to the *Monocystis*. The division of the contents in the two parts of the body he regards as not being a particular membranous partition, but consisting of the same clear, tough fluid, which binds the granules of the contents together.†

The proboscidiform appendage possessed by many species, the author considers as no objection to the simple cell nature of the animal, and as instances of similar cells, refers to the pollen granule, among plants, which often has prolonged growths, (*Auswüchse*,) and the capillaries of the larva of frogs in the course of development, among animals, which then have prolonged solid growths of the cell membrane.

Frantzius, in some concluding remarks upon *Gregarinæ*, in the *Archiv fur Naturgeschichte*, for 1848, p. 190, remarks, that the partition separating the contents of the animal into two parts, he does not consider, with Kölliker, as a thickened layer of the fluid of the body, but, with Stein, thinks it is a partition from the general integuments of the body, which, he continues, is perhaps foreign to the conception of the true cell.‡

Kölliker is so satisfied of the simple cell character of the parasite that in the second vol. of the *Zeitschrift fur Wissenschaftliche Zoologie*, p. 114, he observes, hardly any body will doubt the *Gregarinæ*, with their structureless membrane, simple contents, and nucleus, are in the highest degree like a common cell.

My observations on the genus *Gregarina* of Dufour, lead me to consider it as occupying a much higher position among helminths than has been generally attributed to it, and with Frantzius, Stein, and Henle, as not being a simple organic cell.

* See Proc. Acad. Nat. Sci. vols. 4, 5. † Loc. cit. p. 22.

‡ Die in den Gregarinen vorkommende Scheidewand, die ich nicht wie Kölliker nur für ein verdickte Schichte des flüssigen Körper-inhalts, sondern mit Stein ebenso wie die übrige Körperhülle für eine Membran halte, ist einmal etwa dem Begriff der wahren Zelle Fremdartiges.

The *Gregarina* is a very simple form of entozoon infesting insecta, crustacea, myriapoda, and annelida. In insecta and myriapoda I have usually found them within the proventriculus, but occasionally within the cavity of the abdomen applied to the exterior parietes of the organ just mentioned. They are usually more or less wrinkled or flaccid, except in the full-grown condition, when they are more or less distended with the granular contents.

When the gastric fluid in which the parasite is found is diluted with water, it becomes distended by rapid endosmosis, and soon undergoes destruction. The fluid which I used in examining them, and which I generally use in investigating the delicate tissues of insects, is the blood of the latter. The *Gregarinæ* are not always loose and floating, but are frequently found attached by the posterior end to the delicate transparent epithelial layer, which is so often seen detached in the form of a cylinder from the interior parietes of the proventriculus of insects, and when the animals are separated they may often be observed with a shred of membrane attached, as represented in fig. 8, pl. 10.

A *Gregarina* consists of two portions or divisions of the body, which, for convenience, I will call the cephalic and posterior sac, the former of which is considerably smaller in size than the latter, and is placed anteriorly upon it, or partly in a depression in it, and both are intimately connected together by the tegumentary tunic.

Each sac contains within the interior a mass of granular matter, which, according to the quantity, will appear whitish and translucent, or white and more or less opaque, although the constituent granules of the masses are transparent, resembling oil granules, and measure from a mere point to about the 1.7500th of an inch. The granules are smaller and fainter in the young animals, and in the oldest individuals they exist to such an extent as to give them a milk-white opaque appearance. Frequently there are some granules of a larger size than ordinary mixed with the others, but still preserving the same structure.

Tincture of iodine renders the masses of granular matter brown; ether causes many of the granules to run together and form large globules.

The granules of the masses are held together by a clear, colourless, viscid, albuminoid fluid, which is coloured brown by iodine, and faintly yellow by nitric acid and ammonia.

The parietal tunic of the sacs is colourless, transparent, and structureless, or amorphous in structure. A partition of the same character passes between the two sacs, separating the granular masses from each other.

This tunic is softened or even dissolves in acetic acid; iodine turns it brown; nitric acid and ammonia faintly yellow.

It completely closes the posterior sac from all communication with the exterior and also from the interior of the cephalic sac.

It forms the cephalic sac, which appears also to be closed from the exterior. At the anterior part of this sac it is frequently thickened into a papillary eminence, and sometimes is prolonged into a proboscidiform appendage. I could never ascertain beyond all doubt whether there was not a communication from the interior with the exterior, through this anterior thickening of the tegument. When the animal is submitted to pressure, both sacs may be burst, rarely one into the other, or through the papillary thickening of the

tunic of the cephalic sac, but most commonly at some part of the sides, allowing the contents to escape.

Within the parietal tunic of the posterior sac is a second membrane, which is transparent, colourless, and marked by a most beautiful set of exceedingly regular, parallel, longitudinal lines, which in *Gregarina Juli marginati* measure the 1.9375th of an inch apart; in *G. Blattæ orientalis* the 1.10.000th of an inch; and in *G. Passali cornuti* the 1.15.000th of an inch. This tunic has entirely escaped the notice of all previous observers, and I can account for the circumstance in no other way, than by supposing it has arisen from the inferiority of the microscope made by European continental artists. The lines or markings are easily observed, without any other than the ordinary arrangement for light, by the $\frac{1}{4}$ of an inch, but better the $\frac{1}{12}$th of an inch focal power of the instrument of Messrs. Powell & Lealand.

Of course, if the existence of this second tunic be confirmed, and I have seen it too frequently and plainly to think I have been deceived, the idea of the *Gregarina* being a simple organic cell, is at once exploded.

This tunic I did not detect in the cephalic sac, it appears to go only to the partition dividing the latter from the posterior sac. I have considered it as a muscular or sarcodic structure, because the posterior sac alone is endowed with movement, and as the parietal tunic is the same in both sacs, it is reasonable to conclude the contractile power resides in this second tunic.

Situated in the granular mass of the posterior sac, is to be found one, sometimes two, globular, transparent, colourless, homogeneous, elastic corpuscles, which measure from the 1.4000th to the 1.275th of an inch in diameter. The elasticity of these bodies is so marked, that I have occasionally observed them pressed into a cylindrical form, or constricted into an hour-glass shape, by the contraction of the posterior cell, and upon removal of pressure they would instantly resume their usual appearance.

It is sometimes faintly granular, at other times, in its homogeneous mass may be seen a few scattered, minute, transparent granules. Frequently it contains a nuclear body which is globular, transparent, and homogeneous, with or without one or two nucleoli. Sometimes the nucleus is coarsely granular. Occasionally the corpuscle contains several nuclei.

Movements. Upon the endosmosis of water or saliva into the *Gregarina*, a quite active degree of molecular movement is observable among the granules of the contents.

The contractile movements of the animals, as before observed, take place only in the posterior sac. These appear to be of a muscular character, to such a degree that I was led to the detection of the muscular tunic in seeking for their source. They are slow, and resemble very much the movements produced by the contractile fibres of the dartos membrane of the scrotum.

The posterior sac contracts in any part of its extent without necessarily involving any other part, or it may contract simultaneously throughout. The movements consist of a slow bending of any part of the posterior sac, or constriction of its parietes, or involution of any part, or contraction of the cephalic sac with involution, or general contraction removing any involution, with projection of the cephalic cell if it had been previously retracted.

The older *Gregarinæ*, when distended with granular contents, frequently are quite motionless.

Among the *Gregarinæ* of twenty or thirty different insects and myriapoda, I have preserved notes only of seven, which I append to this communication.

CHARACTER OF THE GENUS.

GREGARINA, Dufour.

Dufour, An. d. Sc. Nat. T. 8, 1826.

Gregarina.—*Dufour*, An. d. Sc. Nat., 1828; *Hammerschmidt*, Isis von Oken, 1838; *Siebold*, Beitr. z., Naturg. d. wirbellosen Thiere, 1839; *Kölliker*, Zeits. f. wiss. Botanik, 1845; Zeits, f. wiss. Zoologie, 1848; *Henle*, Müller's Archiv, 1845; *Frantzius*, Observat, quædam de Gregarinis, 1846; Archiv f. Naturges. 1848; *Stein*, Müller's Archiv, 1848.

Clepsedrina, Rhizinia, Pyxinia, Bullulina, *Hammerschmidt*, Isis von Oken, 1838.

Sporadina, Stylorhynchus, Actinocephalus, *Frantzius*, Archiv f. Naturgeschichte, 1848.

Body consisting of two sacs connected together, composed of amorphous membrane, and filled with granular contents. Anterior or cephalic sac much the smaller. Posterior sac lined with a second tunic, marked with exceedingly regular, parallel, longitudinal lines. Granular mass of the posterior sac containing one or two globular, transparent corpuscles.

1. GREGARINA JULI MARGINATI.

Gregarina larvata, *Leidy*, Proc. Acad. Nat. Sci., vol. iv., p. 232.

Opaque, white, cylindrical or fusiform, narrowed posteriorly, frequently considerably dilated at the anterior third.

Anterior or cephalic sac small, oblate spheroidal, received about one-half into a depression of the inferior cell, surmounted by a papillary elevation or thickening of the parietal integument, which often appears as if there were outlines of a canal or communication with the interior in it; interior filled with a finely granular mass, resembling an aggregation of oil globules; granules measuring from 1.15,000th to 1.7,500th of an inch.

Posterior sac, elongated, cylindrical, or fusiform, obtuse posteriorly; interiorly filled with a granular matter like that of the cephalic sac, rendering the larger or older individuals opaque from its quantity, and one or two large, globular, transparent, homogeneous corpuscles, containing a fine, granular matter, and a round, granular, or transparent nuclear body, in older individuals with one or two nucleoli; interior of the parietal integument invested with delicate and exceedingly regular parallel lines, about the 1.9375th of an inch apart.

Whole length of animal from the 1.200th to the 1.30th of an inch.

Cephalic sac of largest individual, 1.800th in. long; 1.615th in. broad; of smallest 1.1232d in. long.

Breadth of posterior sac, from the 1.830th in. to the 1.111th in.

Corpusele of the posterior sac, in the larger individuals, the 1.375th in. in diameter; its nucleus the 1.967th in.; the nucleolus the 1.1666th in.

Habitation.—Found in considerable numbers in the proventriculus of Julus marginatus, in about two-thirds of the animals examined.

Movements.—This is the most active species which I have ever observed. Individuals are found, generally those of largest size, which are frequently motionless. The movements consist of a contraction, more or less extensive, of the posterior sac. This occurs sometimes to such an extent, that the body will be so narrowed that the parietes come in contact, and the granular contents are divided into two portions, one anterior and the other posterior to the constriction. It will also bend into a sigmoid posture, or roll itself into a helix. At times the cephalic sac is totally drawn within the posterior, and again projected.

2. Gregarina Juli pusilli.

White, translucent, oval.

Cephalic sac hexahedral, with the sides rounded, or forming a double cone, base to base, with the upper apex subacute, or truncated in younger individuals.

Posterior sac robust, oval; granular contents, fine, translucent; interior corpuscle, globular, transparent; nucleus transparent, without nucleolus.

Whole length from the 1.1500th in. to the 1.275th in.

Breadth of largest the 1.500th in.

Diameter of head of largest, 1.1500th in.

Habitation.—Intestine of Julus pusillus.

Movements.—Its movements are not frequent.

3. Gregarina Polydesmi virginiensis.

White, translucent, clavate, spatulate, or oval.

Cephalic sac campanulate, globular, or prolate, or oblate spheroid, surmounted by a papillary thickening of the integument; interior granular mass very fine and translucent.

Posterior sac globular, oval, clavate, spatulate, fusiform, or urceolate; posteriorly obtuse; parietal integument wrinkled or distended; granular contents very fine, faint, translucent; corpuscles, one or two, globular, transparent, very faintly granular.

Whole length from the 1.1000th in. to the 1.28th in.

Breadth from the 1.1000th to the 1.430th in.

Cephalic sac in largest 1.1400th in. long.

Corpuscle 1.3000th to the 1.1000th in. in diameter.

Habitation.—Intestine of Polydesmus virginiensis.

Movements.—Moderate and slow.

4. Gregarina Passali cornuti.

White, opaque, in pairs, wrinkled.

Cephalic sac hemispherical, without papillary thickening of the integument, interior granular mass opaque.

Posterior sac flaccid, when distended subglobular; granular contents opaque white, completely obscuring the interior corpuscle.

Average length, in pair, after distension, 1.66th in.; breadth, the 1.133d in.

Cephalic sac 1.260th in. at base; projects from body cell 1.533d in.

Muscular lines of the posterior sac 1.25000th in. apart.

Habitation.—Proventriculus of Passalus cornutus.

Remarks.—This species is usually found in pairs, the cephalic sac of one applied to the posterior part of the posterior sac of another; a disposition from which Hammerschmidt referred it to a new genus under the name of Clepsidrina. A very trifling degree of pressure is sufficient to separate them from one another.

Movements.—I never observed any other movement in this Gregarina than a slight contractile one, commencing at the anterior part of the posterior sac and proceeding backward.

5. Gregarina Achetæ abbreviatæ.

White, opaque or translucent, with or without a proboscidiform appendage.

Cephalic sac orbicular, or oval, without any papillary thickening of the integument, or occasionally with an oval proboscidiform prolongation; interior granular mass opaque or translucent.

Posterior sac obconic; granular contents opaque; interior corpuscle transparent.

Whole length from the 1.300th to the 1.70th in.
Breadth from 1.600th to the 1.130th in.
Cephalic sac from 1.1140th in. to the 1.250th in.

Habitation.—Proventriculus of Acheta abbreviata. The same species I have observed in two instances on the exterior of the ventriculus, free within the abdominal cavity.

Movements.—Very slow.

6. Gregarina Locustæ Carolinæ.

Opaque, white, with or without a proboscidiform appendage.

Cephalic sac hemispherical, without papillary thickening of the integument, or occasionally with a pyramidal enlargement or extension anteriorly, terminating in a round or oval proboscidiform prolongation, fringed with delicate, membranous digitations at the free extremity, or with an apparent depression of the parietal integument, and a slight conical protrusion of the interior granular mass, which latter is opaque. Partition between the contents of the cephalic and posterior sac very thin.

Posterior sac oblong oval, or spatulate; posteriorly obtuse; granular contents, opaque; interior corpuscle transparent, with several nuclear bodies.

Whole length from the 1.100th to the 1.60th in.
Breadth from the 1.200th to the 1.120th in.
Cephalic sac from the 1.100th to 1.320th in. long; from the 1.270th to the 1.178th in. broad.
Corpuscle, in largest, 1.2800th in. diameter; nuclei 1.3500th in.; nucleoli 1.7000th in.

Habitation.—Intestine of Locusta Carolina.

Movements.—None observed.

7. Gregarina Blattæ orientalis.

Robust, milk-white, opaque.

Cephalic sac hemispherical, with a slight papillary thickening of the integument; contents opaque white. Partition between the cephalic and posterior sac thin.

Posterior sac broad ovate, or panduriform, subacute posteriorly; contents opaque, obscuring the interior corpuscle.

Whole length average 1.50th in.; breadth 1.125th in.
Cephalic sac 1.260th in. long; 1.178th in. broad at the base.
Corpuscle 1.275th in diameter.
Muscular striæ 1.10.000th in. apart.

Habitation.—Within the intestine, and without closely applied to its parietes, in Blatta orientalis.

Movements.—The movements of this species are moderately active.

EXPLANATION OF THE FIGURES. (PLATES 11, 12.)

The figures are all magnified and viewed by transmitted light.

Figs. 1 to 20.—Gregarina Juli marginati.

Fig. 1.—An ordinary form in a state of rest; length 1.25th in.; breadth 1.160th in.

Figs. 2 to 8.—Exhibit various movements of the animal. To the posterior part of figure 8 is observable an attached shred of epithelium.

Figs. 9 to 12.—Represent younger animals in movement; fig. 9 1.80th of an inch long; fig. 10 1.107th in.; fig. 11 1.160th in.; fig. 12 1.57th in.

Fig. 13.—An individual, highly magnified, exhibiting the appearance of the contained granular masses, and also presenting to view two globular, nucleated, corpuscles.

Fig. 14.—The posterior extremity of the same individual more highly magnified. The larger granules at the bottom exhibited very lively molecular movements.

Fig. 15.—A similar individual with the two sacs burst from pressure, and the contained matters escaping. The longitudinal markings of the inner tunic of the posterior sac are represented.

Fig. 16.—Posterior extremity of the same individual, with the contents removed, exhibiting the arrangement of the longitudinal lines.

Fig. 17.—Anterior extremity highly magnified. An apparent canal or opening is represented as existing in the papillary thickening of the integument.

Fig. 18.—Exhibits the relation of the longitudinally lined tunic of the posterior sac to the cephalic sac.

Figs. 19, 20.—The two globular nucleated corpuscles of the posterior sac.

Fig. 21.—Gregarina Juli pusilli. Length 1.250th in.

Fig. 22.—A younger individual. Length 1.1500th in.

Figs. 23 to 29.—Various forms and ages of Gregarina Polydesmi virginiensis.

Fig. 30.—An attached pair of Gregarina Passali cornuti.

Fig. 31.—A single individual of Gregarina Passali cornuti, in outline, representing the longitudinal lines of the posterior sac.

Fig. 32.—Gregarina Achetæ abbreviatæ.

Fig. 33.—A young individual of Gregarina Achetæ abbreviatæ.

Fig. 34.—A young individual of Gregarina Achetæ abbreviatæ, with a proboscidiform appendage.

Figs. 35, 36.—Gregarina Locustæ Carolinæ.

Fig. 37.—Another individual of Gregarina Locustæ Carolinæ, with a remarkable proboscidiform appendage.

Fig. 38.—Corpuscle of the posterior sac of the same individual, with numerous nuclei.

Figs. 39 to 41.—Three forms of Gregarina Blattæ orientalis.

ARTICLE XVI.

Some Observations on Nematoidea Imperfecta, and Descriptions of three Parasitic Infusoriæ. By Joseph Leidy, M. D.

From the obscure position in which entozoa are usually found, but little, comparatively, is known of the continuous history of any of them, and at present it is a quite prevalent opinion among helminthologists, from observations made upon several species of Distoma, that these beings pass through different stages of their existence—sometimes within an animal, at other times without the animal, or within several different animals. If this is the case, it becomes important to present all observed facts in connexion with the development of entozoa, and it is upon such considerations that I have presented the following description of some nematoid entozoa in an imperfect stage of development, or in a stage where no trace of generative apparatus is observable.

1. *Nematoideum cavitatis abdominis Passali cornuti*, (Pl. 11, figs. 42–45.)—This worm is found in the abdominal cavity of the *Passalus cornutus*, among the intestines and rete adiposa in about nine-tenths of the insects. It is met with frequently in great numbers; I have in my collection a vial containing over 5000, obtained from not more than 40 insects. Sometimes not over half a dozen are found, at others as many as 500 may be discovered in a single insect. The worm is usually curved ventrally, and exhibits but little motion until placed in water, when it becomes quite active, wriggling about for twenty-four hours or more.

It is about $1\frac{1}{2}$ lines long, but varies from 1 to 2 lines, and is about 1.150th of an inch wide. The colour is white, opaque; occasionally one or two will be found which are more or less brown or even black, but otherwise they do not differ either in construction or form.

The form is cylindrical, moderately narrowed toward the extremities; anteriorly truncated, posteriorly rounded, and terminated by a short, acute epidermal spine.

The structure is simple, exhibiting within the integument nothing but an alimentary canal and intervening granular matter.

The integument is thin, strong, elastic, transparent, and colourless. It presents a very faint appearance of being finely annulated.

The mouth is round, large, and surrounded by a slightly lobed margin or lip.

The pharynx is short, cylindrical, presents several longitudinal striæ, and opens into a long, wide, cylindrical œsophagus. The latter is but faintly outlined from the general granular structure of the body. It appears to have several longitudinal folds, and at its commencement has a yellowish coloured structure, (pl. 11, fig. 45,) apparently corneous, composed of oval or oblong lobes placed side by side around the commencement of the œsophagus. The ventricular intestine is white, opaque, cylindrical, a little less than the breadth of the cavity of the body, and in length extending to the anal aperture. Its inte-

rior is covered with an epithelial layer, the cells of which are granular, apparently containing oil granules, and measure 1.4200th of an inch in diameter. The posterior extremity of the ventriculus is rounded, and usually contains a large, oblong, translucent, highly refractive mass, of viscid oleo-albuminoid fluid, with several smaller globular masses of the same matter. When the worm is submitted to pressure, a portion of this matter exudes from the anus, with a number of transparent nucleolar and nuclear bodies, but the termination of the ventriculus, or its connexion with the anal aperture is indistinct.

The anus is a short oblique fissure, passing inwards and forwards, upon the ventral surface, a short distance in advance of the posterior extremity of the body. It is bounded by projecting lips, but its communication with the intestinal canal I could not detect. Posterior to the ventriculus, the body is occupied with a fluid, finely granular, and a coarsely granular oil-like matter. The remainder of the intervals of the body is filled with fluid and faintly granular matter.

Measurements.—Length, 1 to 2 lines; breadth at mouth, 1.600th in.; breadth at commencement of ventriculus, 1.280th in.; greatest breadth, about middle, 1.150th in.; breadth just in advance of anus, 1.250th in.; length of caudal spine, 1.2500th in.; from base of spine to anus, 1.300th in.; breadth of ventriculus at commencement, 1.320th in.; breadth of ventriculus at middle, 1.214th in.; breadth of ventriculus at termination, 1.280th in.

This entozoon I have seen in hundreds of the *Passalus*, at all seasons of the year, but in none did I ever discover it in any other stage of development than the one just described.

From the frequency and great numbers in which it is found, I thought it would afford an excellent opportunity to try the experiment, if upon introduction into another animal it would undergo any progress in its development. I accordingly obtained from the forests in our neighbourhood, and through my friend Baird, from the forests near Carlisle, over 200 individuals of *Passalus Cornutus*. A dozen of them I opened, and found them all infested with great numbers of the entozoon just described, and I therefore naturally concluded from this fact, in addition to past experience, that most, or probably all the other insects contained the same. Having obtained a dozen large frogs, (*Rana pipiens*,) after keeping them two weeks until they had voided all indigesta from the alimentary canal, I killed 8 of them, and examined them closely for entozoa. In seven, I found in the lungs *Distomum variegatum;* in all, *Distomum cygnoides* in the bladder; none in the intestines; and in five, an imperfect stage of a species of *Filaria* beneath the mucous coat of the stomach, in the mesentery, and in the abdominal muscles.

The remaining four frogs I then fed daily upon 10 individuals of *Passalus cornutus* each, for four days in succession, so that each frog in that time took 40 insects,—in all, 160. It is not to be presumed that the frogs voluntarily took this prescribed fare, for I was under the necessity of cutting off the legs, elytra, and mouth organs of the insects, and then forcing them into the throat of the frogs.

In twenty-four hours after taking the first involuntary dose of insect food, the frogs commenced voiding the indigestible pergamentaceous segments of the skeleton of the insects per anum, which they continued for a week after the unusual mode of administering their food was stopped.

At the end of two weeks from the commencement of feeding the frogs I killed one of them, and carefully examined the intestinal canal and other organs for the *Nematoideum*

Passali, but not a trace of it was to be found; the cloaca yet contained one or two fragments of the skeleton of the *Passalus*, with some epithelial scales, mucus, and a dark, mud-like, granular matter, but nothing else. The entozoon had been digested with the soft parts of the insect.

Two days after, I killed the remaining frogs, but in none did I discover the slightest trace of the entozoon in question. From the results thus obtained, we may conclude that this parasite finds no condition favourable to its existence, leaving out of the question entirely any farther development, in frogs, or probably in any reptile. But still the entozoon may pass part of its existence in other animals. In a state of nature, frogs would rarely have a chance of feasting upon *Passalus*,* because the latter is found in forests, beneath bark and in the wood of decaying dead trees, and here the woodpecker (*Picus*,) or other insectivorous birds would be most likely to meet with it, and with such birds a similar experiment, to the one performed with frogs, might be tried to see if the development of the entozoon would not advance within them.

2. *Nematoideum thoracis cavitatis Passali cornuti*, (pl. 11, fig. 46.)—This is an anguillula-like worm in an imperfect condition, found occasionally in the cavity of the thorax of *Passalus cornutus*. It resembles an embryonic *Ascaris*. Its movements are active and wriggling. It is whitish, translucent, cylindrical, and attenuated and acute posteriorly.

Structure.—Integument transparent, and colourless. Œsophagus long, narrow, cylindrical, and faintly outlined. Intestine broad, cylindrical, granular in appearance and faintly outlined. Anus an oblique fissure, not very distinct, just in advance of the tail, which latter is short and acute.

Length, 1.66th in.; breadth, 1.1000th in.

3. *Nematoideum intestinorum Armadillonis pillularis*, (pl. 11, fig. 47.)—This is also an anguillula-like entozoon, found coiled up and adhering by the mouth to the epithelial layer of the intestine of *Armadillo pillularis*. It is white, cylindrical, attenuated, and acute posteriorly. The intestinal canal presents the same appearance as in the last, but the œsophagus is broader.

Length, 1.53d in.; breadth, 1.360th in.

4. *Nematoideum integumenti Lumbriculi limosi*, (pl. 11, fig. 48.)—This is a small entozoon which I found, six in number, doubled up and motionless, contained in transparent oval cysts, imbedded in the integument of the 9th, 11th, and 15th, annuli of a *Lumbriculus limosus*. It resembled an embryo within an ovum. Its form is cylindrical, subacute posteriorly, truncated anteriorly, colourless and transparent. No interior organs were observable, except a small, round, transparent corpuscle posteriorly, and anteriorly, a proboscidiform body, partly projecting from the anterior extremity.

Length, 1.560th of an inch.

* The habitation of Passalus, however, offers no reason why a frog or toad should not occasionally feast upon them. At one time I thought the insect was confined to the haunts in which it is usually found, but it undoubtedly flies at night, as I have found it in places where some days before they did not exist, and my late friend Dr. Benj. Kern, once brought me half a pint of this insect, which he obtained on the Atlantic ocean, a few miles from shore, with numerous other insects, one morning after there had been a brisk wind in the night.

Nyctotherus.*—*Proc. Acad. Nat. Sci., vol.* 4, *p.* 233.

Body ovate, finely vibrillated, dilated posteriorly, compressed anteriorly; investing tunic granular and marked with longitudinal lines; antero-inferiorly and middle line of the body furnished with a semicircle of large vibrillæ, anterior to which is a large, granular, areola; posteriorly, with a short fissure passing inwards and downwards.

1. Nyctotherus velox.—(Pl. 11, fig. 49, a. b. c. d.) *Proc. Acad. Nat. Sci., vol.* 4, *p.* 233.

Body white, translucent, ovate; anteriorly obtusely rounded; posteriorly angular. Anterior areola faintly granular, trapezoidal, with bulging sides. Interiorly furnished with several minute vacuolæ, and usually one large and globular situated just at the end of the posterior fissure.

Length, from 1.254th to 1.180th in.; breadth, from 1.320th to 1.254th in.

This species is found in the commencement of the large intestine of *Julus marginatus*, occasionally in thousands. It moves with great ease and grace in the water, and after some time the external tunic bursts and allows large globules of the sarcodic mass to protrude, which often separate, as in fig. 49 *d.*, and the animal is gradually destroyed.

2. Nyctotherus ovalis.—(Pl. 11, fig. 50.) *Proc. Acad. Nat. Sci., vol.* 5, *p.* 100.

Translucent, oval; posteriorly, obtuse. Anterior areola large, granular. Posterior fissure passing downwards.

Length, 1.187th in.; breadth, 1.250th in.†

Found in the intestinum tenue of the *Blatta orientalis*, occasionally in large numbers.

Bodo Julidis.—(Pl. 11, fig. 51.) *Proc. Acad. Nat. Sci., vol.* 5, *p.* 100.

Body translucent, faintly greenish, faintly granular, with one or two large round vacuolæ, and numerous minute ones; form changing, usually globular, oval, or pyriform; caudæ twice the length of the body, very active, frequently becoming twisted into a ring at the extremity.

Diameter of body, 1.3000th of an inch.

This animalcule is found in the large intestine of *Julus marginatus*, with *Nycotherus velox*, often in millions.

REFERENCES TO FIGURES. (PLATE 11.)

Figures all magnified.

Figs. 42—45.—*Nematoideum cavitatis abdominis Passali cornuti.*

43.—Posterior extremity in outline.

44.—Posterior extremity. The large internal transparent masses are observable, and portions of fluid and nuclear bodies expressed from the anus.

45.—Anterior extremity.

46.—*N. cavitatis thoracis P. cornuti.*

47.—*N. intestinorum Armadillonis pillularis.* A portion of membrane is observable attached to the mouth.

48.—*N. integumenti Lumbriculi limosi*, doubled up within its sac..

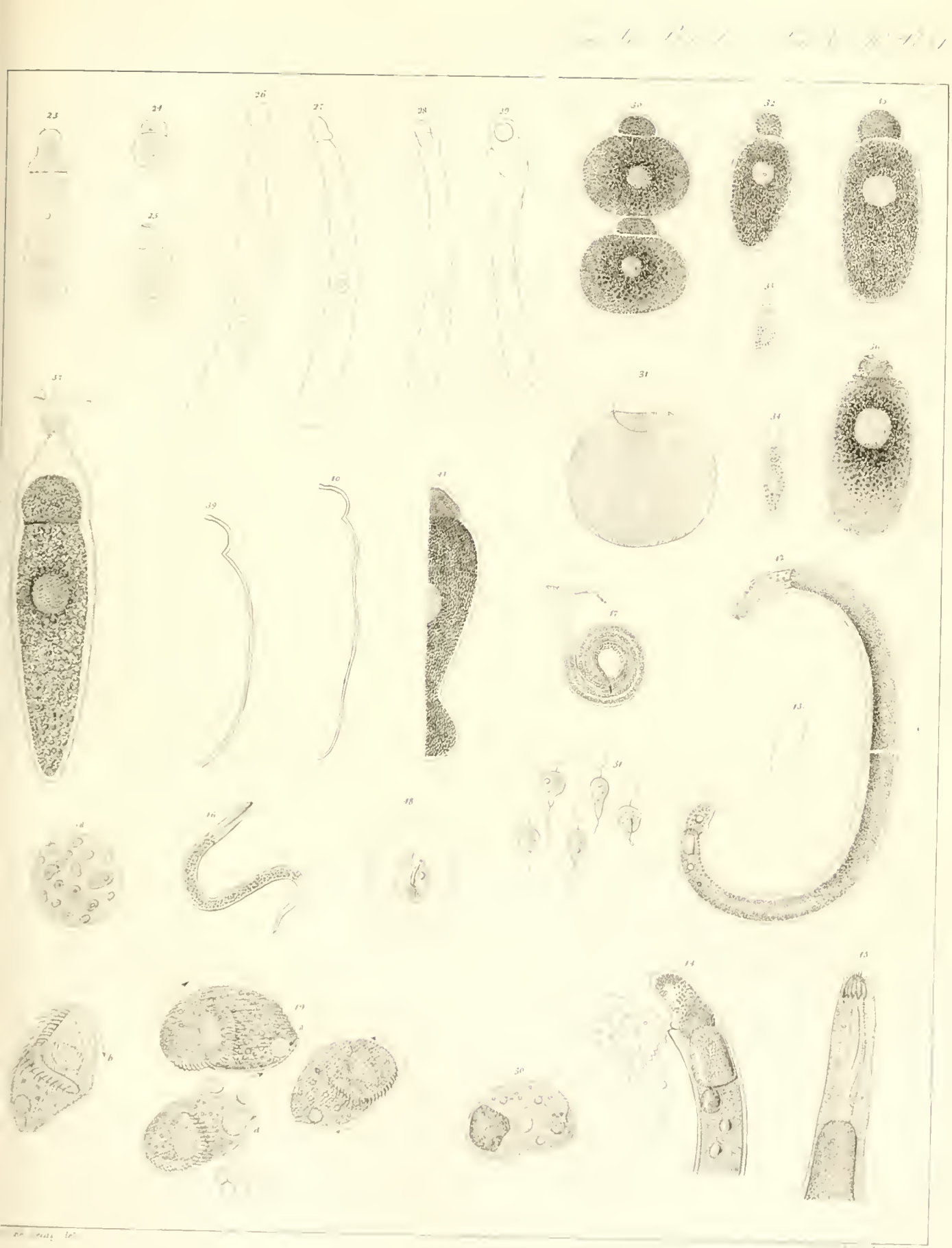
49.—*a, b, c, d*, Nyctotherus velox.

50.—N. ovalis.

51.—Bodo Julidis.

* Νυκτοθήρας.

† The measurements given in the Proc. Acad. Nat. Sci. are erroneous, being a mistake of the printer.



ARTICLE XVII.

Meteorological Observations, Napa-Keang, (Loo-Choo,) 1848-49. Made by Dr. Bettelheim. Read Jan. 16th, 1852.

Philadelphia, February 16th, 1852.

Dear Sir:

The meteorological observations taken at the Loo-Choo Islands are the result of the industry of Rev. Dr. Bettelheim, M. D., a missionary at Napa-Keang, Grand Loo-Choo Island. Having but a limited supply of paper, he was obliged to crowd his notes; and as I had but a few hours in which to copy them, it was impossible to arrange them in a different form. He had a very fine marine barometer, and a thermometer of Fahrenheit.

The force of winds, &c., were placed according to usual nautical parlance.

His residence was upon the Capstan Rock, Lat. 26° 13′, N.; Long. 127° 54′, E.

I hope that, from the fact that no observations of any length of time having been previously made in that portion of the ocean, these may be of some interest.

Very truly,

JOHN L. BURT, M. D., U. S. N.

Isaac Lea, Esq.

DAYS	MAY.		JUNE.	
	11 A. M.	4 P. M.	11 A. M.	3 P. M.
1	Heavy rain, wind S.	Heavy rain, wind S.	(6 A. M. E. 69°. Fine) N. E. 79°. Fine	N. E. 82°. Fine
2	Rainy, wind S. E.	Rain ceased, wind E.	(E. 70°. Fine)	S. E. 82°. Cloudy
3	Wind E. Ther. 79°	{ Weather clear, Wind E. Ther. 81°	(S. E. 73°. Fine) S. by W. 82°. Fine	S. by W. 82°. Fine
4	Fine, E. 80°	N. E. 82°	(S. by E. 76°. Fine) Fine	S. 84°. Fine
5	Cloudy, sultry, 78°	79½°	Rain before morning (S. E. 78°. Fine) S. W. 80°. Rainy	W. 84°. Fine
6	Hazy, E. 78°	{ Rainy. S. E. 77° Much rain all night.	S. W. 83°. Fine	W. 84°. Fine
7	{ 6 A. M. S. W. 75° W. 70°	{ Rainy. N. W. 73° 9 P. M. N. Cold	(W. 80°. Fine)	(1 P. M. W. 86°. Fine) N. E. 85. Cloudy
8	(6 A. M. N. 70°. Cold) E. 74°. Clearing up	N. W. 72°. Clearing up	S. 84°. Fine	{ W. 84°. Fine Rain all night
9	(6 A. M. N. E. 72°. Cloudy) N. 76. Fine.	N. 78°. Fine	(S. 76°. Fine) S. 83°. Fine	S. 84°. Fine
10	(N. by W. 67°. Cloudy) N. E. 69°. Cloudy, cold	W. 67°. Cloudy, cold (6 P. M. Rainy)	(S. E. 80°. Fine) S. E. 85°. Fine	Fine
11	(N. E. 64°. Clear) N. E. 76°. Clear	E. 77°. Fine	(S. E. 80°. Cloudy) 83°. Much wind and cloudy.	W. by N. Cloudy and rainy
12	(N. E. 71°. Cloudy) E. 74°. Good rain	73°. Rainy	S. W. 83°. Occasional showers, whole night rain	W. by S. 80°. Cloudy
13	(S. 75°. Clear) 77°	S. 76°. Rainy	(W. 78°. Rainy) Whole morning rain	{ S. by W. 78°. Clearing Night rain
14	(N. E. 75°. Hazy. Fine	Fine	(N. 76°. Continual heavy rain) N. E. 77°. Rain	N. by E. 77°. Cloudy Afternoon and night rain
15	(E. 70°. Fine) N. E. 80°. Very fine.	81°. Fine	(N. E. 73°. Rain) S. by W. 74°. Rain	E. 74°. Constant rain, whole night
16	(E. 70°. Fine) N. 79°. Fine	80°. Fine	(N. by E. 74°. Clearing) S. E. 81°. Pretty clear	N. by W. 82° Pretty clear
17	(S. E. 74°. Clear) W. 80°. Clear	S. E. 81°. Clear	(N. E. 79°. Rain) Rain	{ W. by S. 74°. Rain Evening, constant small rain
18	(S. 71°. Clear) 80°	S. E. 81°. Clear	(S. by E. 78°. Clearing) Clear	E. by S. 83°. Clearing
19	(W. 76. Cloudy) N. by W. 72°. Rain	{ 68°. Wind from all points Rain, showery, cold 66° all night	(W. by S. 80°. Cloudy, rain) Rain	Rain
20	(N. by E. 66°. Rainy) N. E. 70°. Rainy	{ E. 70°. Rain Night rain	Rain	Rain
21	(70°. Rain) 72°. Rain } E.	E. 72°. Strong rain	80°. Rain	Rain
22	(S. 74°. Clearing) W. 77°. Rainy	W. 78°. Raining	Rain	Rain
23	E. 82°. Bright, hot.	W. 78°. Strong rain.	Rain	Rain
24	(S. E. 75°. Clear) W. 82°. Clear	W. 82°. Clear	(N. by E. 71°. Rain) S. 76°. Strong rain	N. 78°. Raining
25	(S. W. 81. Bright)	S. W. 80°. Cloudy	(1 P. M. E. 82°. Clearing)	Clearing. Rain all night
26	(N. W. 76°. Strong rain)	N. W. 76°. Strong rain	(S. 76°. Constant rain W. 79°. do do	N. by W. 80° (Constant rain all night)
27	N. by E. 81°. Fine	N. by E. 82°. Fine.	(W. 74°. Rain) W. by S. 82°. Sunshine	S. by W. 82°. Cloudy
28	(E. 76°. Fine) E. 82°. Fine	S. 82°. Somewhat cloudy	(S. 80°. Clearing) S. W. 82°. Sun.	N. W. 84°. Misty
29	(N. by E. 76°. Cloudy) N. E. 84°. Bright	N. 81°. Fine	(S. W. 79°. Fine) S. W. 83°. Fine	W. by S. 81°. Fine
30	(N. by E. 74°. All cloudy) N. by E. 80°. Fine	N. 80°. Fine	(S. W. 79°. Fine) S. W. 85°. Fine	S. W. 85°. Fine
31	N. 81°. Fine	N. by E. 81°. Fine		

DAYS	JULY.		AUGUST.	
	11 A. M.	3 P. M.	11 A. M.	3 P. M.
1	(6 A. M. S. 79°. Fine) W. 84°. Fine	S. W. 85°. Fine	E. 85°. Cloudy	E. 82°. Cloudy
2	(W. 79°. Fine) Noon. W. 84°. Fine	S. W. In sun, 114°. Fin	(S. E. 80°. Cloudy) E. 82°. Cloudy	E. 83°. Cloudy
3	(S. 80°. Fine) S. E. 88°. Fine	S. E. 88°. Fine (In sun, 109°.)	E. 85°. Fine	E. 85°. Fine
4	(S. by E. 77°. Showers) S. E. 80°. Fine	S. E. 82°. Cloudy and stormy (Night storm, showers)	(E. 76°. Fine) E. 85°. Fine	E. 86°. Cloudy
5	(W. 76° Fair) W. by S. Fair	W. by S. Fair (In sun, 86°)	(S. E. 71°. Fine) N. 85°. Fine	W. 86°. Fine
6	(W. 79°. Fair) W. 84°. Fair	S. W. 84°. Fine	(E. by S. 76°. Fine)	S. 84°. Showery
7	W. 85°. Fair	S. W. 85°. Fine	S. E. 82°. Fair	S. 85°. Fine
8	(S. by E. 80°. Fine) S. by E. 84°. Fine	S. W. 84°. Cloudy	S. W. 82°. Fair	S. W. 84°. Fine
9	(S. E. 80°. Cloudy) S. E. Fine	S. E. Fine	S. W. 84°. Fine	S. W. 86°. Fine
10	(S. E. 78°. Fine) S. E. 85°. Fine	S. 85°. Fine	(S. by E. 80°. Fine) S. W. 85°. Fine	S. W. 86°. Fine (96° in sun)
11	(E. by S. 76°. Fine) E. 91°. Fine	E. 90°. Cloudy	(S. E. 83°. Fine) S. E. 89°. Hot	E. by S. 91°. Fine (110° in sun)
12	(E. 78°. Fine) 91°. Hot	E. hot. Fine (In sun, 100°)	(E. by S. 80°. Fine) E. by S. 90°. Fine, hot	E. 92°. Hot (108° in sun)
13	(W. 77°. Fine) S. 90°. Fine	" 102°. S. Fine	(E. 83°. Fine) E. Fine, hot	E. 90°. Fine
14	(E. 77°. Cloudy) E. 92°. Cloudy	E. Sun, 99°. Cloudy	(E. 86°. Cloudy) E. 88°.	{ E. 86°. Stormy { Evening do
15	(W. by N. 78°. Fine) N. W. 88°. Hot	W. hot, fine (In sun, 102°.)	(80°. Stormy) 81°. Stor., cloudy, showers	82°. Stormy, showers
16	E. Fine Occasional showers	E. fine, occasional showers	E. 82°. Showers	E. 80°. Cloudy
17	(N. E. 78°. Cloudy) N. E. 82°. Showery	N. E. 84°. Showery	E. 86°. Fine	E. 87°. Fine
18	In sun. 81°. Stormy and showery; all night the same.	In sun, 81°. Stormy and showery all night	E. 88°. Fine	E. 87°. Fine
19	(N. E. 79°. Raining) S. W. 79°. Stormy—rain	S. W. 78°. Showery	E. 83°. Fine	E. 89°. Fine
20	(S. E. 80°. Clearing) S. E. 80°.	S. 81°. Clear, night rain	S. E. 86. Cloudy	S. 88°. Fine
21	(S. 73°. Cloudy, showers, E. 81°.	E. 83°. Stormy Strong night rain	S. 84°. Cloudy	S. 82°. Rainy
22	(E. 77°. Cloudy) E. 80°. Cloudy)	E. 81°. Cloudy	S. 81°. Cloudy	S. 86°. Fine
23	(S. W. 77°. Cloudy)	Rainy	S. 84°. Cloudy	S. 84°. Cloudy
24	(E. by S. 77°. Rainy) E. by S. 79°. Cloudy	Windy; cloudy	S. 83°. Cloudy	S. 86°. Cloudy
25	S. E. 78°. Rain	E. by S. 78°. Rain	N. E. 86°. Cloudy	S. E. 87°. Cloudy
26	E. 78°. Cloudy	E. by S. 83°. Cloudy	S. E. 90°. Cloudy	E. 88°. Fine
27	(S. E. 79°. Clear) S. E. 78°. Cloudy	N. by E. Cloudy	86°. Fine	Calm. 88°. Fine
28	(S. E. 79°. Clear) E. by S. 83°. Cloudy	E. 84°. Fine	88°. Fine	87°. Fine
29	(S. E. 78°. Clear) E. by S. 81°. Clear	E. 87°. Fine	77°. Fine) 88°. Cloudy	86°. Cloudy
30	(E. 80°. Clear) Clear	Clear	86°. Cloudy	S. 80°. A short shower
31	(S. E. 77°. Cloudy) E. 84°. Cloudy	E. by S. 86°. Cloudy	E. 88°. Fine	E. 90°. Fine, night rain

DAYS	SEPTEMBER.		OCTOBER.	
	11 A. M.	3 P. M.	11 A. M.	3 P. M.
1	E. 88°. Fine	E. 90°. Fine		S. 83°. Rainy
2	86°. Fine	89°. Fine	86°. Fine	89°. Fine
3	E. Fine	E. 88°. Fine	N. 84°. Cloudy	N. 82°. Cloudy
4	E. 86°. Fine	86°. Fine	N. E. 82°. Nice	N. E. 77°. Cloudy
5	S. W. 86°. Cloudy	S. W. 86°. Cloudy	E. by N. 86°. Fine	E. by N. 83°. Showers
6	S. W. 79°. Cloudy, rain	Typhoon rain S. Rain all night	E. 86°. Cloudy	E. 82°. Rainy
7	N. E. 80°. Rain	N. E. 80°. Cloudy	E. by S. 80°. Rainy	E. by S. 80°. Rainy
8	N. E. 82°. Fine	N. E. 82°. Fine	Rainy	Rainy
9	N. E. 83°. Fine	N. E. 84°. Fine	Rainy	Rainy; do at night
10	E. Fine	E. 85°. Fine	N. 80°. Showers	S. 80°. Fine Night rain
11	E. by S. 83.° Cloudy	{ E. by S. 83°. Cloudy { Night rains	E. 87°. Fine	E. 85°. Fine Night rain
12	E. 89°. Fine	E. 82°. Cloudy	E. 85°. Fine, showers	E. 84°. Fine Night rain
13	S. E. 80°. Rain	S. E. 77°. Rainy	{ S. E. 83°. Fine { Showers	S. E. 84°. Showers
14	N. E. 83°. Fine	N. 77°. Rainy	E. 86°. Fine	E. 88°. Fine
15	N. 89°. Fine	N. 83°. Fine	E. Fine	E. Cloudy
16	N. 82°. Fine	N. 83°. Cloudy	E. 83°. Clouded	N. E. 80°. Cloudy
17	W. by S. 83°. Fine	S. W. 86°. Fine	E. 85°. Cloudy	E. 86°. Fine
18	W. Fine	4 P. M., W. 84. Cloudy	N. E. 82°. Showery	E. 81°. Cloudy
19	S. W. 86°. Cloudy	N. W. 87°. Cloudy	E. 84°. Clouds	E. 86°. Fine, showers
20	W. 86°. Cloudy	W. 87°. Cloudy	E. by S. 84°. Cloudy	S. E. 84°. Fine, clouds
21	S. 83°. Rainy	S. 79°. Rainy	S. 82°. Cloudy	S. W. 84°. Fine
22	N. E. 80°. Rain	N. W. 78°. Rainy	W. Showery	W. Showery
23	N. 79°. Fine	N. 81°. Fine	N. E. 72°. Cloudy	N. E. 72°. Cloudy
24	N. Fine	N. Fine	N. N. E. 76°. Fine	N. N. E. 74°. Cloudy
25	N. Fine	N. Fine	N. N. E. 76°. Cloudy	N. E. 76°. Cloudy
26	83°. Fine	84°. Fine	N. N. E. 79°. Rain	N. E. 74°. Cloudy
27	Fine	Fine	N. E. 76°. Cloudy	N. E. 76°. Cloudy
28	Fine	Fine	N. E. 84°. Fine	N. E. 82°. Fine
29	89°. Fine	90°. Fine	N. E. Fine	N. E. Fine
30	89°. Fine	90°. Fine	N. E. 87°. Fine	N. E. 82°. Fine
31			E. by N. 71°. Fine	E. by N. 70°. Rain

DAYS	NOVEMBER.		DECEMBER.	
	11 A. M.	3 P. M.	11 A. M.	3 P. M.
1	N. E. 74°. Fair	E. by N. 73°. Fine	62°. Rain	62°. Cloudy
2	(N. E. 67°. Fair) N. E. 74°. Cloudy	N. E. 74°. Cloudy	N. E. 72°. Fine	N. E. 69°. Cloudy
3	(N. E. 69°. Fine) N. E. 80°. Fine	N. E. 83°. Fine	Pretty	Pretty
4	(76°.) N. E. 82°. Showery	N. E. 82°. Fine	N. E. 68°. Pretty	N. E. 69°. Pretty
5	(77°.)	84°. Fine.	72°. Fine	73°. Fine
6	N. E. 82°. Cloudy	N. E. 80°. Cloudy Night rain	78°. Fine	79°. Fine
7	E. 70°. Rainy	E. by N. 73°. Fine	N. E. 70°. Cloudy	76°. Fine
8	N. E. 82°. Fine	N. E. 80°. Fine	N. E. 76°. Fine	
9	N. E. 80°. Cloudy	N. E. 80°. Cloudy		
10	N. E. 71°. Rainy	N. E. 75°. Rainy		
11	N. E. 66°. Rain	N. by E. 64°. Rainy		
12				
13	N. E. 72°. Fine	N. E. 69°. Fine		
14	N. E. 68°. Pretty	N. E. 66°. Cloudy	N. E. 69°. Cloudy	70°. Cloudy
15	N. E. 68°. Rainy	N. E. 68°. Rainy	68°. Rainy	68°. Rainy
16	N. E. 67°. Rain	Rain	67°. Rain	Rainy
17	N. by E. 68°. Cloudy	N. by E. 68°. Cloudy	72°. Rainy	71°. Rain Night rain
18	N. by E. 72°. Fine	N. by E. 72°. Fine	Pretty	Clouds
19			N. E. 85°. Cloudy	N. E. 64°. Rain
20	N. by E. 66°. Cloudy	N. by E. 66°. Cloudy	N. E. 76°. Fine	67°. Rain Night rain
21	69°. Rainy	N. by E. 68°. Rainy	N. E. 70°. Fair	N. by E. 68°. Fair Night rain
22	N. by E. 68°. Cloudy	N. by E. 68°. Cloudy	Fair	Rainy
23	N. by E. 68°. Cloudy	N. by E. 68°. Pretty		
24	N. by E. 68°. Rainy	N. by E. 65°. Rain	N. E. 70°. Fine	N. E. 68°. Fine
25			N. E. 70°. Fair	68°. Rain
26			73°. Fine	74°. Fine
27	N. by E. 70°. Pretty	N. by E. 79°. Fine	74°. Fine	76°. Fine
28	78°. Fine	78°. Fine (90° in sun)	75°. Fine	76°. Fine
29	N. by E. 68°. Pretty	N. by E. 68°. Cloudy	71°. Pretty	70°. Fine
30	N. by E. 66°. Cloudy	N. by E. 66°. Cloudy	75°. Fine	Cloudy
31			Rainy	

DAYS	JANUARY.		FEBRUARY.	
	11 A. M.	3 P. M.	11 A. M.	3 P. M.
1	N. by E. 68°. Cloudy	N. by E. 61°. Cloudy	N. by E. 67°. Rainy	N. by E. 65°. Rainy
2	74°. Fine	72°. Fine	N. E. 64°. Cloudy	N. E. 64°. Cloudy
3	71°. Fine	72°. Fine	N. by E. 64°. Cloudy	N. by E. 64°. Cloudy
4	N. by E. 68°. Cloudy	N. by E. 70°. Cloudy	Pretty	Pretty
5	80°. Fine	73°. Fine	N. by E. 74°. Cloudy	N. by E. 67°. Cloudy
6	74°. Fine	74°. Fine	N. by E. 68°. Cloudy	65°. Cloudy
7	Fine	Cloudy; night rain	70°. Fine	Fine
8	N. E. 67°. Cloudy	N. E. 62°. Cloudy	Fine	71°. Fine
9	N. E. 58°. Pretty	N. E. 57°. Cloudy, rain	73°. Fine	72°. Fine
10	68°. Fine (56°)	70°. Fine	N. by E. 73°. Fair	N. by E., 71°. Fine
11	69°. Fine	70°. Fine	Cloudy	Cloudy
12	N. E. 68°. Fine	N. E. 69°. Fine	N. by E. Fine	N. by E. Fine
13	70°. Fine	75°. Fine	S. E. Fine	S. E. Fine
14	Fair	Fair	N. E. 65°. Cloudy	N. E. 67°. Cloudy
15	N. E. 72°. Rainy	68°. Rainy	N. E. 67°. Cloudy	E. by N. 65°. Cloudy
16	N. E. 58°. Cloudy	N. E. 57°. Cloudy	N. E. Fine	N. E. 70°. Fine
17	(52°) N. E. 53°. Cloudy	N. E. 53°. Cloudy	S. E. 72°. Fine	S. E. 73°. Fine
18	N. E. 59°. Pretty	N. E. 62°. Pretty	S. by E. Fine	S. by E. 53°. Fine
19	N. E. 53°. Fine	N. E. 65°. Fine	S. 75°. Fine	S. 75°. Fine
20	N. E. 65°. Fine	N. E. 66. Fine	S. 75°. Cloudy	S. 74°. Cloudy
21	Pretty	Pretty	77°. Fine	79°. Fine
22	Cloudy	Cloudy	74°. Fine	74°. Fine
23	Cloudy, rain	76°. Cloudy	S. E. 75°. Cloudy (10 A. M., thunder)	S. E. 76°. Cloudy
24	Pretty	Pretty	S. 67°. Rainy	S. 65°. Rainy
25	N. 64°. Pretty	N. 66°. Pretty	E. Fair	E. Cloudy
26	N. by E. 66°. Pretty	E. 64°. Rainy	N. W. 77°. Fair	N. 76°. Cloudy
27	(N. E. 61°. Cloudy) 64°. Stormy	N. by E. 62°. Rain	S. 76°. Fine	S. 75°. Rain
28	(N. by E. 58°. Cloudy) do do	N. E. 58°. Cloudy	E. 74°. Pretty	E. 72°. Rain
29	N. by E. 62°. Cloudy	N. by E. 65°. Fine		
30	67°. Fine	66°. Fine		
31	68°. Fine	68°. Fine		

DAYS	MARCH		APRIL	
	11 A. M.	3 P. M.	11 A. M.	3 P. M.
1	E. 75°. Rainy	E. 79°. Pretty		S. E. 76°. Fine
2	N. 65°. Cloudy and rain	N. 64°. Rainy	N. E. 66°. Rainy	N. by E. 64°. Rainy
3	N. by E. 61°. Pretty	N. by E. 62°. Pretty	N. by E. 58°. Rainy	N. by E. 58°. Rainy
4	N. 55°. Raining	N. 58°. Showers	N. by E. Cloudy	N. by E. 60°. Cloudy
5	N. by E. 56°. Cloudy	N. by E. 56°. Cloudy	N. by E. 71°. Fine	Fine
6	S. E. 72°. Fair	S. E. 71°. Rain	Fine	Fine
7	E. 64°. Cloudy	N. 62°. Cloudy	N. E. 72°. Fine	N. E. 72°. Fine
8				
9				
10				
11				
12		E. 78°. Fine		
13	S. E. 75°. Fine	S. E. 73°. Rainy	Maximum of Thermometer { 6 A. M., 86° / 11 A. M., 92° / 4 P. M., 92° / In sun, 114°	
14	N. by E. 62°. Rainy	N. by E. 58°. Cloudy		
15	N. by E. 56°. Cloudy	N. by E. 58°. Cloudy		
16	N. by E. 53°. Fine	N. 62°. Fine		
17	N. E. 63°. Rainy	N. E. 63°. Rainy		
18	Rain	Rain	Minimum of Thermometer { 6 A. M., 52° / 11 A. M., 53° / 4 P. M., 53° / In sun, 81°	
19	N. E. 62°. Cloudy	N. E. 60°. Pretty		
20	N. E. 72°. Fine	N. E. 71°. Fine		
21	E. 74°. Fine	E. 74°. Cloudy		
22	E. 71°. Fine	E. 71°. Fine		
23	S. E. 73°. Pretty	N. E. 70°. Pretty		
24	Pretty	Pretty		
25	Pretty	Pretty		
26	S. E. 72°. Rain	S. E. 74°. Pretty		
27	N. E. 71°. Fine	N. E. 73°. Pretty		
28	E. Rain showers	E. Rain showers		
29	Pretty	E. by N. 72°. Pretty		
30	E. by S. 76°. Fine	E. by S. 74°. Fine		
31	S. E. 76°. Fine	S. E. 76°. Fine		

ARTICLE XVIII.

Descriptions of New Species of the Family Unionidæ. By Isaac Lea. Read March 5th, 1852.

It is now some years since I presented to this society a continuation of my discoveries of new forms from the fresh waters and soil of the United States. Since that period, owing to the kindness of many valued friends, I have been enabled to get together a much larger number by far, than could have been anticipated. These have come chiefly from localities hitherto little examined, and which have produced new species more or less interesting. It will be observed that many are from Dr. Barratt, of Abbeville District, S. C., from Mr. Tuomey, of Alabama, Dr. Hale, of Alexandria, Louisiana, Prof. Powell, of Memphis, Major Le Conte, who procured them from Florida and Georgia, President Estabrook, of Knoxville, Tenn., Mr. Joseph Clark, of Cincinnati, Mr. C. M. Wheatley, of New York, and other kind friends. To them all, I return my sincere thanks for their liberality, and I trust that they will be induced not to flag in the cause of American science, but rather to be encouraged in the development of these new organic forms, which, in this branch of Zoology exist in such vast profusion, and in so extended a number of species, in the United States.

Notwithstanding the vast number of well characterized species of the Family *Unionidæ*, (as there are also in the Family *Melaniana*,) there are continually new and distinct forms brought to our notice, which well deserve the attention of the American Zoologist.

I am aware that many persons doubt the existence of so extended a production of species, but this arises from the want of a knowledge of them, closely cultivated and analytically examined. An organic form, instituted by nature must be recognised as distinct, for it will remain in a state of autonomy to the end of its term. It is the duty of the zoologist to bring to the investigation an eye practised in discrimination, and a judgment experienced in analysis, as well as also an honest intention of purpose, that he may give the best and most accurate results to his investigations.

Unio sordidis. Pl. XII. Fig. 1.

Testâ lævi, elliptică, subcompressâ, inequilaterali, posticè rotundatâ: valvulis subcrassis: natibus prominulis: epidermide rufo-fuscâ, striatâ; dentibus cardinalibus parvis; lateralibus longis subrectisque; margaritâ albâ et iridescente.

Shell smooth, elliptical, rather compressed, inequilateral, rounded behind; valves rather thick; beaks slightly prominent; epidermis reddish-brown, striate; cardinal teeth small; lateral teeth long and nearly straight; nacre white and iridescent.

Hab. Abbeville District, S. C. J. P. Barratt, M. D.
My cabinet.

Diam. .8, Length 1.3, Breadth 2.4 inches.

Shell smooth, elliptical, rather compressed, inequilateral, rounded before and behind; substance of the shell rather thick, thinner behind; beaks slightly prominent and nearly terminal; ligament long and thick; epidermis reddish-brown, obtusely rayed, with obscure equidistant marks of growth; umbonial slope rounded; cardinal teeth very small and striate, single in the right and double in the left valve; lateral teeth long and nearly straight, separated from the cardinal tooth; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices nearly in the centre of the cavity of the beak, under the cardinal tooth; cavity of the shell shallow; cavity of the beaks very shallow and subangular; nacre white and iridescent.

Remarks.—A single imperfect specimen only of this was received by me, and I hesitated for some time to describe it, in hopes of getting more to determine its characters better, It is certainly very much like the widely distribnted *U. complanatus;* but it seems to me to differ in its form, being more rounded behind, more rounded over the umbones, and more compressed over the umbonial slope.

Unio Gibbesianus. Pl. XII. Fig. 2.

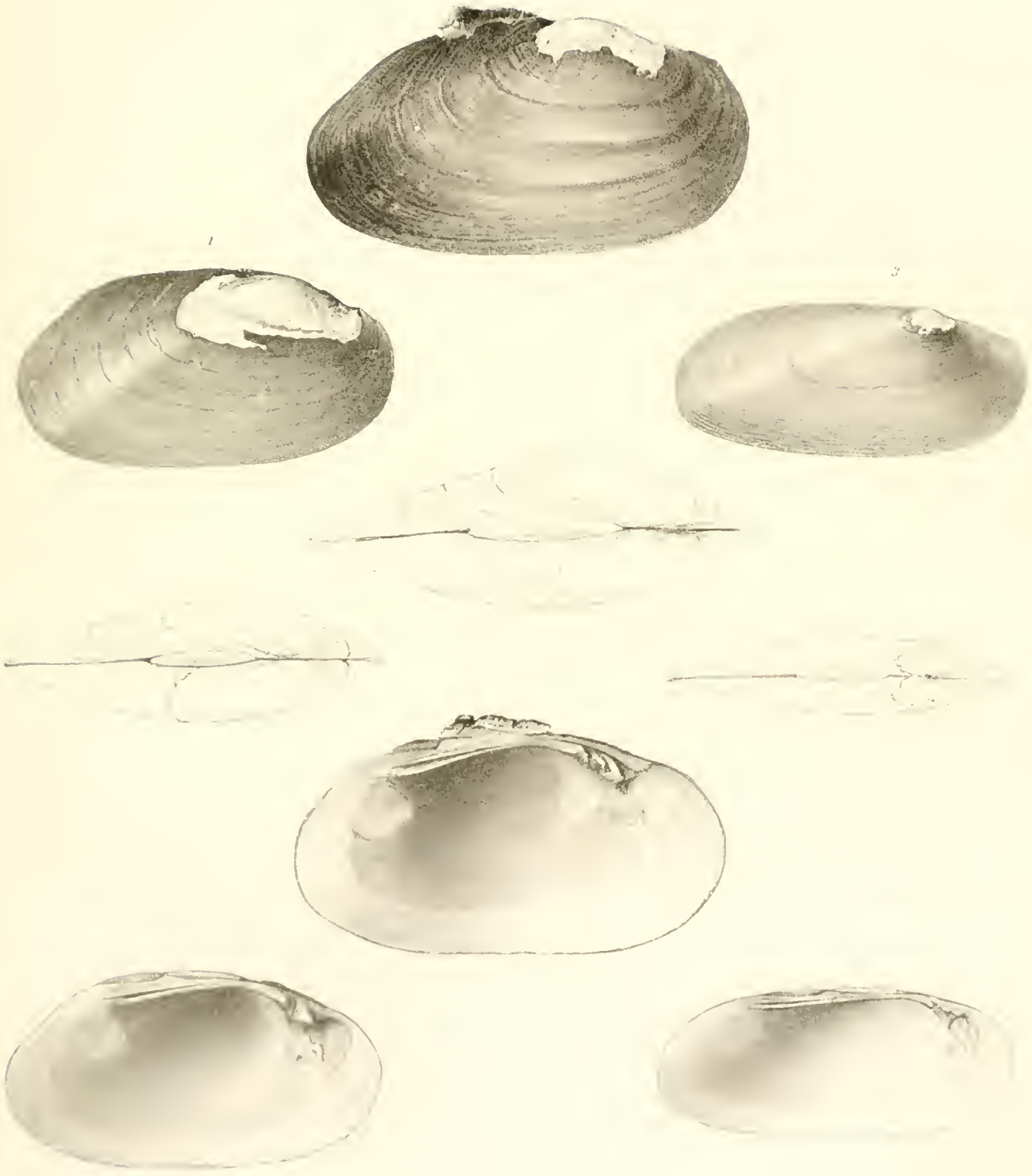
Testâ lævi, elliptică, subcompressâ, inequilaterali, postieè subbiangulatâ; valvulis subcrassis; natibus prominentibus; epidermide luteo-fuscâ, radiatâ, striatâ; dentibus cardinalibus parvis, tripartitis; lateralibus prælongis subrectisque; margaritâ albâ et iridescente.

Shell smooth, elliptical, somewhat compressed, inequilateral, subbiangular behind; valves rather thick; beaks prominent; epidermis yellowish-brown, radiated, striated; cardinal teeth small; lateral teeth very long and nearly straight; nacre white and iridescent.

Hab. Abbeville District, S. C. Louis R. Gibbes, M. D.
My cabinet.

Diam. 1, Length 1.5, Breadth 2.8 inches.

Shell smooth, elliptical, somewhat compressed, inequilateral, rounded before and subbiangular behind; substance of the shell thick; beaks prominent and submedial; ligament long and very thick; epidermis yellowish-brown, obscurely radiated, roughly striate near the margin, smooth on the umbones, marks of growth nearly equidistant and distinct; umbonial slope rounded; cardinal teeth small, slightly elevated, pointed and tripartite; lateral teeth very long, nearly straight and thickened at the posterior end, separated from the cardinal tooth; anterior cicatrices distinct; posterior cicatrices distinct; dorsal cica-



1 *Unio sordidus*
2 " *Gibbosionus*
3 " *perstratus*

trices nearly in the centre of the cavity of the beaks, on the inferior posterior part of the cardinal tooth; palleal cicatrices distinctly impressed; cavity of the shell shallow, cavity of the beaks shallow and subangular; nacre white and iridescent.

Remarks.—It is to be particularly regretted that a single specimen only of this species should have been received from Dr. Gibbes. The cardinal teeth in *both valves are tripartite.* They are distinctly divided into three lobes, of nearly equal size and form. This is so unique that I have inserted it with some hesitation as a permanent character, tripartition being so unprecedented. It may possibly be accidental. Should other specimens prove this form to be persistent, this species will present an anomaly peculiarly its own. The lateral teeth are, as usual, single in the right and double in the left valve; but the terminal inferior portion is remarkably enlarged and thickened in the latter valve, so as to run beyond the superior portion. The marginal portion of the disc is remarkably furnished with imbricate epidermal matter. It has somewhat the outline of *U. complanatus*, but may easily be distinguished from that species by its being more elevated in the beaks, in its imbricate margin, and in the form of the teeth.

Unio perstriatus. Pl. XII. Fig. 3.

Testâ lævi, valdè transversâ, valdè compressâ, subemarginatâ, valdè inæquilaterali, posticè subbiangulatâ; valvulis tenuibus; natibus parvis, vix prominentibus, ad apicem undulatus; epidermide luteo-fuscâ, perstriatâ; dentibus cardinalibus parvis, obliquis; lateralibus prælongis rectisque; margaritâ albâ et iridescente.

Shell smooth, very transverse, very much compressed, subemarginate, very inequilateral, subbiangular behind; valves thin; beaks small, scarcely prominent, undulated at the tip; epidermis yellowish-brown, very much striated; cardinal teeth small, oblique; lateral teeth very long and straight; nacre white and iridescent.

Hab. Abbeville District, S. C. J. P. Barratt, M. D.
My cabinet and cabinet of Dr. Barratt.

Diam. .5, Length 1, Breadth 2.3 inches.

Shell smooth, very transverse, very much compressed, slightly emarginate, very inequilateral, subbiangular behind, obtusely rounded before, posterior slope wide and flattened; substance of the shell thin; beaks placed near to the anterior margin and furnished with minute undulations at the tip, scarcely prominent, but rather pointed; ligament long and thin; epidermis yellowish-brown, with numerous imbricate striæ covering nearly the whole of the disks, and with only one or two distant marks of growth; umbonial slope biangular and flattened; cardinal teeth small, oblique, double in the right and single in the left valve; lateral teeth very long, straight and thickened at the posterior ends; anterior cicatrices distinct; dorsal cicatrices placed under the plate between the cardinal and lateral teeth; cavity of the shell exceedingly shallow; cavity of the beaks very shallow and rounded; nacre white and iridescent.

Remarks.—Dr. Barratt sent me four specimens of this species, which may easily be distinguished by its peculiar striated epidermis, and its compressed form. It scarcely belongs to that large group of which the *U. complanatus* is the type, but certainly borders on it. The nacre of three of the specimens is white, slightly tinged with blue. The fourth specimen is purplish. The lines of growth are very remarkable, being few and

very distant, neither of the specimens having more than two, and two of them having only one line of growth. In outline it closely resembles *U. strigosus*, (Nobis,) but is a rougher shell, and thinner.

Unio Tuomeyi. Pl. XIII. Fig. 4.

Testâ lævi, ellipticâ, subcompressâ; valvulis subcrassis; natibus vix prominulis; epidermide lutco-fuscâ; dentibus cardinalibus subgrandibus; lateralibus longis, subcrassis curvisque; margaritâ iridescente, colore salmonis tinctâ.

Shell smooth, elliptical, rather compressed; valves somewhat thick; beaks slightly prominent; epidermis yellowish-brown; cardinal teeth rather large; lateral teeth long, rather thick and curved; nacre iridescent, salmon coloured.

Hab. Abbeville District, S. C. J. P. Barratt, M. D.

My cabinet and cabinets of Dr. Barratt and Mr. Tuomey.

Diam. .8, Length 1.3, Breadth, 2.6 inches.

Shell smooth, elliptical, rather compressed, subangular behind, rounded before, slightly angular on the posterior slope; substance of the shell somewhat thick; beaks slightly prominent, with minute undulations at the tip; ligament rather long and thin; epidermis yellowish-brown, shining, with indistinct rays on the posterior portion; cardinal teeth rather large, somewhat pointed, single in the right and double in the left valve; lateral teeth long, curved and thickened at the posterior end; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed in the cavity of the beaks; cavity of the shell shallow; cavity of the beaks small and slightly angular; nacre iridescent and salmon coloured.

Remarks.—There were seven specimens of this species among the shells sent to me by Dr. Barratt and Mr. Tuomey. They are of different ages, and nearly allied to *U. Barrattii*, herein described, but may be distinguished by being more compressed and less transverse. All of the seven specimens before me have salmon coloured nacre, except one, which is mixed with a tinge of purple. Other specimens may likely be found with white and purple nacre.

Unio Barrattii. Pl. XIII. Fig. 5.

Testâ lævi, transversâ, subinflatâ; valvulis subcrassis; natibus vix prominulis; epidermide virido-fuscâ; dentibus cardinalibus grandibus; lateralibus longis, subcrassis subcurvisque; margaritâ vel albâ vel purpurâ vel colore salmonis tinctâ.

Shell smooth, transverse, slightly inflated; valves somewhat thick; beaks slightly prominent; epidermis greenish-brown; cardinal teeth large; lateral teeth long, somewhat thick, and rather curved; nacre white-purple or salmon coloured.

Hab. Abbeville District, S. C. J. P. Barratt, M. D.

My cabinet and cabinets of Dr. Barratt and Mr. Tuomey.

Diam. .8, Length 1.3, Breadth 2.9 inches.

Shell smooth, transverse, slightly inflated, angular behind and rounded before, angular on the posterior slope, subcarinate on the posterior dorsal margin; substance of the shell somewhat thick; beaks slightly prominent, with minute undulations at the tip; ligament

4. Unio Tunneri
5. " Barratti
6. " decurtus

rather long and thin; epidermis greenish, clouded with brown, slightly polished, with rather minute, indistinct rays; cardinal teeth large, pointed, single in the right and double in the left valve; lateral teeth long, somewhat curved and thickened at the posterior end; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed in the centre of the cavity of the beaks; cavity of the shell shallow; cavity of the beaks small and rather angular; nacre white, purplish, or delicately salmon coloured and iridescent.

Remarks.—Among many interesting species—several of which were new—received from Dr. Barratt and Mr. Tuomey, were four of this species. One is an adult, the other three are young. It has somewhat the outline of *U. rectus*, Lam., and has on the exterior a resemblance to *U. nasutus*, Say, but is a thicker shell. It is not so cylindrical as the *rectus*, nor so wide. It is allied to *U. Tuomeyi*, but is a wider species.

Unio decoratus. Pl. XIII. Fig. 6.

Testâ oblongâ, valdè compressâ, inæquilaterali; valvulis subtenuibus; natibus prominulis, compressis, ad apices undulatis: epidermide luteo-viridi, densissimè radiatâ; dentibus cardinalibus parvis, lamellatis; lateralibus parvis rectisque; margaritâ albâ et iridiscente.

Shell oblong, much compressed, inequilateral; valves rather thin; beaks slightly prominent, compressed, undulated at the beaks; epidermis yellowish-green, closely radiated; cardinal teeth small, lamellar; lateral teeth small and straight; nacre white and iridescent.

Hab. Abbeville District, S. C. Dr. Barratt and Mr. Tuomey.

My cabinet and cabinets of Dr. Barratt and Mr. Tuomey.

Diam. .8, Length 1.4, Breadth 2.3 inches.

Shell oblong, much compressed; posterior dorsal margin carinate; substance of the shell rather thin, slightly thickened before; beaks slightly prominent, compressed and crowded with double concentric undulations; ligament very small, thin, nearly concealed within the valves; epidermis yellowish-green, with numerous capillary rays over nearly the whole disk; cardinal teeth rather small, lamellar, single in the right and double in the left valve; lateral teeth rather short, straight and acicular; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices situated in the point of the cavity of the beaks; cavity of the shell rather shallow; cavity of the beaks small and angular; nacre white, rather brilliant and iridescent.

Remarks.—I owe to the kindness of Dr. Barratt and Mr. Tuomey four specimens of this interesting species, which draws more attention from the fact of its forming a natural link with a highly interesting species which I described and figured in Vol. III., Trans. Am. Phil. Soc., Pl. XII. Fig. 22, under the name of *Symphynota* (*Unio*) *compressa*, afterwards changed to *pressus*. It differs from the *pressus*, however, in being less oblong, in being rather more inflated and less lenticular. In the teeth, while there is a strong assimilation to that peculiar character of the *pressus*, there is a marked difference; the elevation of the posterior portion of the cardinal tooth being very much less, and the two bifid portions much closed. The umbonial slope is disposed to be angular. The transverse striæ are close. The marks of growth distant. This species, like *U. pressus*, has the symphynote character of the wing.

Unio rufusculus. Pl. XIV. Fig. 7.

Testâ lævi, ellipticâ, subcompressâ, inæquilaterali, posticè biangulatâ; valvulis subcrassibus; natibus subprominentibus; epidermide tenebroso-fuscâ, striatâ; dentibus cardinalibus obliquis, parvis striatisque; lateralibus remotis, longis, lamellatis, rectis; margaritâ vel albâ vel salmonis colore tinctâ.

Shell smooth, elliptical, rather compressed, inequilateral, biangular behind; valves rather thick; beaks somewhat prominent; epidermis dark-brown, striate; cardinal teeth oblique, small and striate; lateral teeth remote, long, lamellar and straight; nacre white or salmon coloured.

Hab. Abbeville District, S. C. J. P. Barratt, M. D.
My cabinet.

Diam. .9, Length 1.4, Breadth 2.4 inches.

Shell smooth, elliptical, rather compressed, inequilateral, biangular behind, rounded before, substance of the shell rather thick, thicker before; beaks somewhat prominent and submedial; ligament rather long and thick; epidermis dark-brown, obscurely rayed on the posterior slope, striate towards the margin, with obscure, nearly equidistant marks of growth; umbonial slope subangular; cardinal teeth oblique, small, with regular striæ; single in the right and double in the left valve; lateral teeth separated from the cardinal tooth, long, lamellar, straight, and slightly thickened towards the posterior end; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed rather above the centre of the cavity of the beaks; cavity of the shell rather shallow; cavity of the beaks very small; nacre white or salmon coloured.

Remarks.—This species belongs to the group of which the common *U. complanatus* is the type. It seems to stand between it and *U. Congaræus*, (Nobis.) It is more angular on the umbonial slope than *complanatus*, and less so than *Congaræus*. Of the three specimens received, two are salmon coloured. The oldest specimen is very thick and much eroded. The youngest is rather thin. The outline of this species is very much like the figure of *Unio planilateris*, Conrad, but it differs in the colour of the epidermis, in the thickness of the teeth, and the obliqueness of the umbonial slope. It is also very like *U. fulvus*, (Nobis,) which also came from South Carolina; and it is possible that when good suites are brought together, this species may prove to be only the adult of a flatter variety of *fulvus*.

Unio Whiteianus. Pl. XIV. Fig. 8.

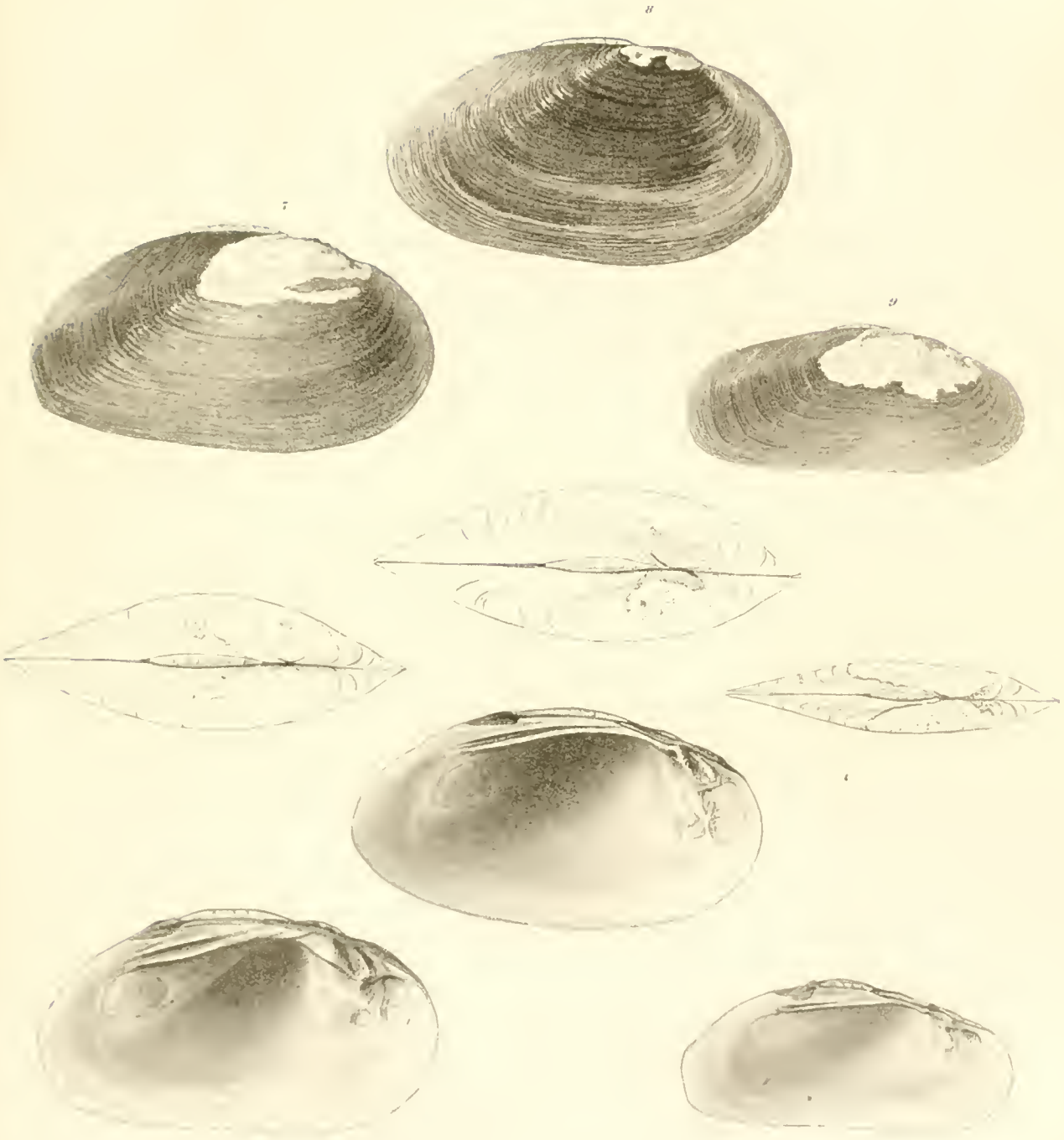
Testâ lævi, ellipticâ, inflatâ, valdè inæquilaterali, posticè subangulatâ; valvulis crassis; natibus subprominentibus; epidermide vel tenebroso-fuscâ vel nigrâ, striatâ, ad apices politâ; dentibus cardinalibus magnis, elevatis, crenulatis; lateralibus longis subcurvisque; margaritâ vel albâ vel salmonis colore tinctâ.

Shell smooth, elliptical, inflated, very inequilateral, subangular behind; valves thick; beaks somewhat prominent; epidermis dark-brown or black, striate, towards the beaks polished; cardinal teeth large, elevated, crenulated; lateral teeth long and somewhat curved; nacre white or salmon coloured.

Hab. near Savannah, Geo. Rev. G. White.
My cabinet and cabinet of Mr. White.

Diam. .1, Length 1.4, Breadth 2.5 inches.

Shell smooth, elliptical, inflated, very inequilateral, rounded before, subangular behind; substance of the shell thick; beaks somewhat prominent; placed towards the anterior



7. Unio radiatus
8. " Whitianus
9. " Luxurus.

margin; ligament short and thick; epidermis dark-brown or black, roughly striate on the margin, but smooth and highly polished on the sides and towards the beaks; marks of growth rather indistinct and distant; umbonial slope rounded; cardinal teeth large, elevated, crenulated, pointed, single in the right and double in the left valve; lateral teeth long, rather thick, somewhat curved and separated from the cardinal tooth; anterior cicatrices distinct; posterior cicatrices distinct; dorsal cicatrices placed nearly in the centre of the cavity of the beaks; cavity of the shell rather deep; cavity of the beaks shallow and rounded; nacre usually salmon coloured, sometimes white.

Remarks.—Many of this species were sent to me by Mr. White. None of the beaks are sufficiently perfect to detect the undulations of the tips. The form and size of this species approaches closely to *U. confertus* and *U. Geddingsianus*, (Nobis.) It may be distinguished from them, however, by the remarkable polish of the superior portion of the disk and the beaks, and by the rough striæ of the other portion of the epidermis. The adult specimens are all very dark-brown or black. The younger shells are yellowish, with numerous dark-green rays over nearly the whole disk. Some of the adult specimens are quite straight on the basal margin, and almost falcate.

Unio Lazarus. Pl. XIV. Fig. 9.

Testâ lævi, arcuatâ, valdè transversâ, compressâ, valdè inæquilaterali, posticè subbiangulatâ; valvulis pertenuibus; natibus undulatis, vix prominentibus; epidermide tenebroso-fuscâ, rugoso-striatâ; dentibus cardinalibus minimis; lateralibus longis, acicularis, remotis rectisque; margaritâ vel albâ vel purpureâ et valdè iridescente.

Shell smooth, arcuate, very wide, compressed, very inequilateral; subbiangular behind; valves very thin; beaks undulated, scarcely prominent; epidermis dark-brown, roughly striate; cardinal teeth very small; lateral teeth long, acicular, remote and straight; nacre white or purple and very iridescent.

Hab. Abbeville District, S. C. J. P. Barratt, M. D.
My cabinet and cabinet of Dr. Barratt.

Diam. .4, Length .9, Breadth 2 inches.

Shell smooth, emarginate at base, very wide, compressed, very inequilateral, behind subbiangular, before rounded; posterior slope wide and flattened; substance of the shell very thin, thicker before; beaks placed near to the anterior margin, furnished with very minute undulations at the tip, scarcely prominent and very small; ligament long and thin; epidermis dark-brown, roughly striate, with obscure marks of growth; umbonial slope biangular; cardinal teeth very small, crenulate, double in the left and single in the right valve; lateral teeth long, separated from the cardinal tooth, acicular, straight and slightly turned up at the extreme posterior point; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices small and placed under the plate posterior to the cardinal tooth; cavity of the shell very shallow; cavity of the beaks very shallow and rounded; nacre white or purple.

Remarks.—This is a small, very thin and fragile species. The young have very much the appearance of the young of the elongate variety of *U. complanatus*, but the adult and middle aged are arcuate, and cannot be mistaken for that species. The young are

greenish, with obscure rays, and the undulations of the beaks are less pronounced than those of the *complanatus*. It is somewhat like *U. folliculatus*, (Nobis,) but is a thinner and less transverse species. The older specimens are very much compressed in the middle, near to the basal margin.

Unio merus. Pl. XV. Fig. 10.

Testâ lævi, elliptică, subinflatâ; valvulis crassis; natibus subprominentibus, ad apices undulatis; epidermide luteâ, radiatâ, nitidâ; dentibus cardinalibus magnis, crenulatis; lateralibus longis, rectis, à cardinalibus separatis; margaritâ albâ et iridescente.

Shell smooth, elliptical, somewhat inflated; valves thick; beaks somewhat prominent, undulated at the beaks; epidermis yellow, radiated, shining; cardinal teeth large, crenulate; lateral teeth long, straight and separated from the cardinal tooth; nacre white and iridescent.

Hab. Abbeville District, S. C. J. P. Barratt, M. D.
My cabinet and cabinet of Dr. Barratt.

Diam. .6, Length 1, Breadth 1.5 inches.

Shell smooth, elliptical, rather inflated, somewhat striate, rounded before and angular behind; substance of the shell thick, thinner behind; beaks somewhat prominent, rather coarsely undulated at the tip; ligament short and rather thick; epidermis yellow, obscurely radiated, shining; umbonial slope subangular; marks of growth distant and distinct; cardinal teeth large, compressed, crenulate, pointed, single in the right and double in the left valve; lateral teeth long, straight, lamellar, separated from the cardinal tooth; anterior cicatrices approximate; posterior cicatrices confluent; dorsal cicatrices situated on the under side of the cardinal tooth; cavity of the shell shallow; cavity of the beaks small and angular; nacre white and iridescent.

Remarks.—In its general character, this species resembles *U. Congaræus*, (Nobis.) It is not, however, so much compressed, and the angle of the umbonial slope is much less expressed. Of the six specimens before me, five have white nacre. The sixth and largest is slightly tinted with salmon colour.

Unio concavus. Pl. XV. Fig. 11.

Testâ lævi, elliptică, inflatâ; valvulis subtenuibus; natibus prominulis; epidermide pallido-luteolâ, viridostriatâ; dentibus cardinalibus parvis, compressis; lateralibus longis rectisque; margaritâ albâ et iridescente.

Shell smooth, elliptical, inflated; valves rather thin; beaks slightly prominent; epidermis pale-yellow, with green rays; cardinal teeth small and compressed; lateral teeth long and straight; nacre white and iridescent.

Hab. Abbeville District, S. C. J. P. Barratt, M. D.
My cabinet.

Diam. .8, Length 1.2, Breadth 2.2 inches.

Shell smooth, elliptical, inflated, rounded before and subangular behind; substance of the shell rather thin, slightly thickened before; beaks slightly prominent, nearly medial; ligament rather long and thin; epidermis pale-yellow, with numerous green rays reaching to the margin, smooth and polished, scarcely showing the lines of growth; cardinal teeth compressed, single in both valves, and abruptly terminated; lateral teeth long, straight,

and slightly elevated; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices within the cavity of the beaks; cavity of the shell deep and rounded; cavity of the beaks shallow and subangular; nacre white and iridescent.

Remarks.—A single adult specimen only has been received from Dr. Barratt, with two quite young ones. The beaks of one of these are sufficiently perfect to show that the undulations extend some distance from the point, and that they are rather complex. The young are rayed over the whole disk. The adult specimen has many dark-green rays over the posterior portion, but none on the anterior portion. This species is somewhat like *Unio cariosus*, Say, but is more regularly elliptical and more transverse. The young specimens very much resemble the young of *U. radiatus*.

Unio ineptus. Pl. XV. Fig. 12.

Testâ lævi, elliptica, subcompressâ: valvulis tenuibus: natibus vix prominentibus, ad apices undulatis: epidermide valdè tenebrosâ, striatâ: dentibus cardinalibus parvis, compressis; lateralibus longis, subrectis, a cardinalibus separatis: margaritâ cæruleâ.

Shell smooth, elliptical, somewhat compressed; valves thin; beaks scarcely prominent, undulated at the beaks; epidermis very dark and striated; cardinal teeth small, compressed; lateral teeth long, nearly straight and separated from the cardinal tooth; nacre bluish.

Hab. Abbeville District, S. C. J. P. Barratt, M. D.
My cabinet.

Diam. .4, Length .7, Breadth 1.3 inches.

Shell smooth, elliptical, somewhat compressed, rounded before and subangular behind; substance of the shell thin; beaks small, scarcely prominent; undulated rather coarsely at the tip; ligament short and thin; epidermis much striated, very dark-brown, nearly black; umbonial slope rounded; marks of growth indistinct; cardinal teeth small, compressed, crenulate, double in the left and single in the right valve; lateral teeth long, nearly straight, thickened at the posterior end; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed nearly in the centre of the cavity of the beaks; cavity of the shell very shallow; cavity of the beaks very shallow and angular; nacre bluish.

Remarks.—A single specimen only of this species is before me, and may not be adult. It is quite small, and somewhat like *U. fabalis*, (Nobis,) of our western rivers, but is still more closely allied, in general form and colour, to *U. faba*, D'Orb. It differs from the former in being a thin shell, and having a more elevated posterior slope, and from the latter in having the sides more compressed, and in the beaks having irregular undulations, while the *faba* has the radiated folds so peculiar to most of the South American species. The specimen of *ineptus* before me has two obscure rays on the posterior slope, none being apparent over the disk. More perfect specimens may present rays.

Unio buxeus. Pl. XV. Fig. 13.

Testâ lævi, elliptică, subinflatâ: valvulis subcrassis: natibus subprominentibus: epidermide tenebroso-fuscâ: dentibus cardinalibus subparvis erectisque: lateralibus longis subrectisque: margaritâ albâ et iridescente.

Shell smooth, elliptical, rather inflated; valves somewhat thick; beaks somewhat prominent; epidermis dark-brown; cardinal teeth rather small and erect; lateral teeth long and nearly straight; nacre white and iridescent.

Hab. Abbeville District, S. C. J. P. Barratt, M. D.
My cabinet and cabinet of Dr. Barratt.

Diam. .7, Length 1, Breadth 1.7 inches.

Shell smooth, elliptical, rather inflated, rounded before and angular behind; substance of the shell rather thick, thinner behind; beaks somewhat prominent, submedial; ligament rather short and thin; epidermis dark-brown, with obscure rays, very smooth and polished; marks of growth distant, regular and well marked; cardinal teeth rather small, compressed, double in the left and single in the right valve; lateral teeth long, nearly straight and enlarged at the posterior end; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed on the under side of the cardinal tooth; cavity of the shell rather shallow; cavity of the beaks shallow and angular; nacre white and iridescent.

Remarks.—Dr. Barratt sent me three specimens of this species, one only being adult. Neither of them have the beaks sufficiently perfect to show any undulations. In outline it resembles *U. concavus*, (Nobis,) but it is more compressed, and differs much in the colour of the epidermis and the rays. The adult specimen is slightly salmon coloured in the cavity of the beaks. One of the younger specimens is distinctly salmon coloured.

Unio pygmæus. Pl. XV. Fig. 14.

Testâ lævi, elliptică, subcompressâ, striatâ; valvulis subtenuibus; natibus subprominentibus; epidermide tenebroso-fuscâ; dentibus cardinalibus parvis; lateralibus linearis subcurvisque; margaritâ cæruleâ et iridescente.

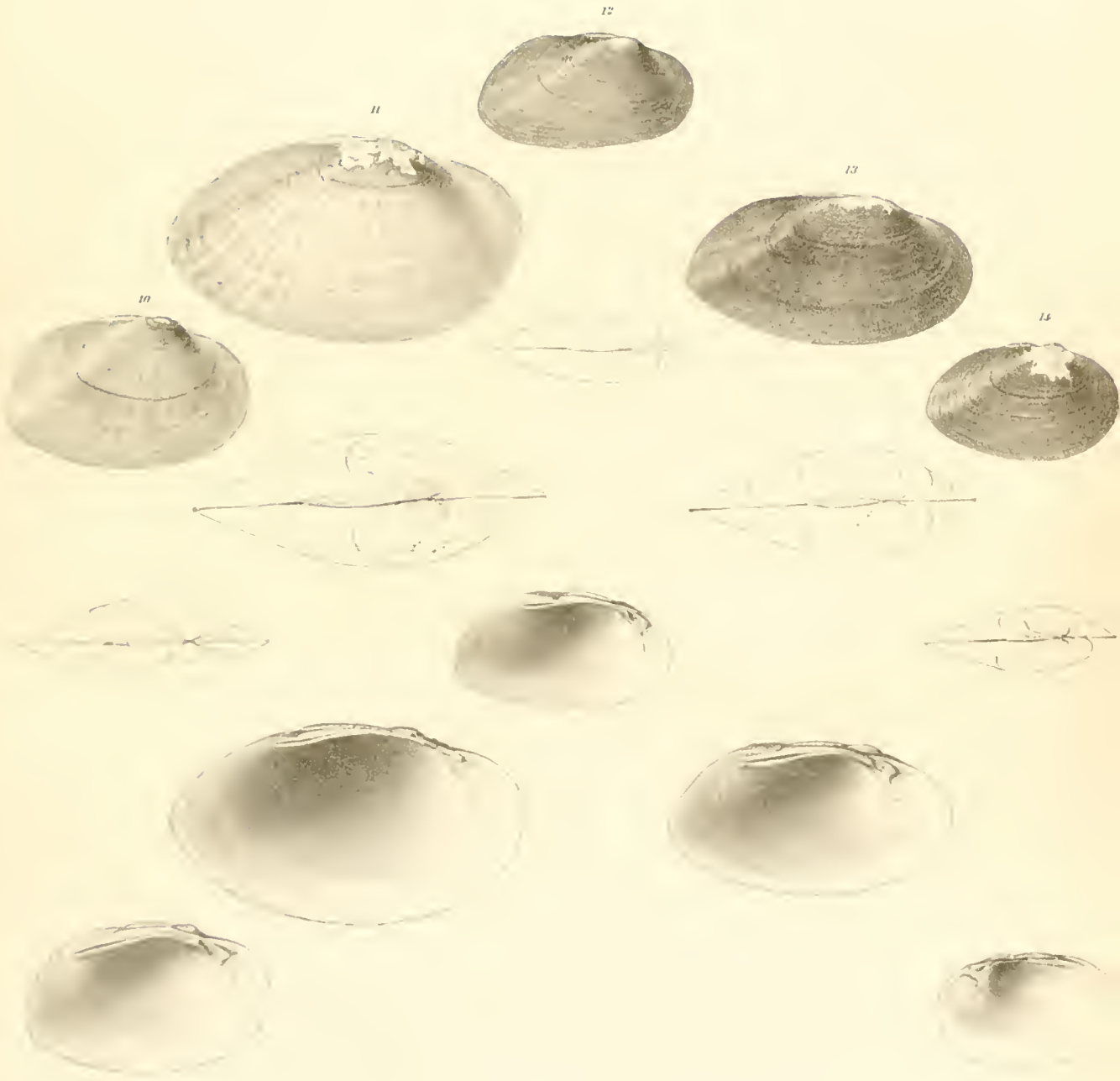
Shell smooth, elliptical, rather compressed, striate; valves rather thin; beaks somewhat prominent; epidermis dark-brown; cardinal teeth small; lateral teeth linear and slightly curved; nacre bluish and iridescent.

Hab. Abbeville District, S. C. J. P. Barratt, M. D.
My cabinet.

Diam. .4, Length .7, Breadth 1.2 inches.

Shell smooth, elliptical, rather compressed, striate, rounded before and angular behind; substance of the shell rather thin, thicker before; beaks somewhat prominent; ligament short and thin; epidermis dark-brown, striate, with obscure rays, and slightly polished; umbonial slope angular; marks of growth indistinct; cardinal teeth small, compressed; lateral teeth rather long, linear, slightly curved, and thickened at the posterior end; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices in the centre of the cavity of the beaks; cavity of the shell shallow; cavity of the beaks small and angular; nacre blue and very iridescent behind.

Remarks.—This is a very small species, and a single valve only, (the right) has been received by me. I do not think this is quite adult. The beak is not sufficiently perfect to observe any undulations. This shell is about the size of *U. fabalis*, (Nobis,) and *parvus*, Barnes, but cannot be confounded with either of them. It is a thinner shell than the former and less inflated than the latter.



10. Unio mecus
11. " concavus
12. " ineptus
13. " buxeus.
14. " pygmaeus

Unio fraternus. Pl. XVI. Fig. 15.

Testâ lævi, elliptică, compressâ, striatâ, valdè inequilaterali, posticè subbiangulari; valvulis suberassis; natibus prominulis; epidermide tenebroso-fusca; dentibus cardinalibus parvis, tuberculatis, striatis; lateralibus prælongis subcurvisque; margaritâ vel albâ vel purpureâ et iridescente.

Shell smooth, elliptical, compressed, striate, very inequilateral, subbiangular behind; valves rather thick; beaks somewhat prominent; epidermis dark-brown; cardinal teeth small, tuberculate, striate; lateral teeth very long and somewhat curved; nacre white or purple and iridescent.

Hab. Columbus, Georgia, Dr. Boykin; Abbeville District, S. C., J. P. Barratt, M. D.
My cabinet and cabinet of Dr. Barratt.

Diam. .6, Length 1.3, Breadth 1.4 inches.

Shell smooth, elliptical, compressed, striate, very inequilateral, subbiangular behind, obtusely rounded before, flattened on the sides; substance of the shell somewhat thick, thinner behind; beaks somewhat prominent and placed near to the anterior margin; ligament long and rather thick; epidermis very dark-brown, darker on the posterior slope, with distant marks of growth; posterior slope compressed, with fold-like wrinkles, and raised into a carina; umbonial slope obtusely angular; cardinal teeth small, tuberculate and striate; lateral teeth very long, somewhat curved, thicker at the posterior end and separated from the cardinal tooth; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed in a row on the interior of the plate; palleal cicatrix impressed; cavity of the shell very shallow; cavity of the beaks very shallow and rounded; nacre white or purple and iridescent.

Remarks.—This species belongs to the group of which *U. complanatus* is the type. It is closely allied to *U. Hopetonensis*, (Nobis,) but differs in being more elliptical in the outline, and having a less elevated carina, and in the cardinal teeth, which are not compressed. The outline is more that of *Unio Hembeli*, Con., but it is not so thick a shell, and does not possess the coarse folds on the posterior slope, which in that species distinguish it so well. The *Hembeli* is also darker, the striæ coarser, and the umbonial slope more rounded. Of the six specimens before me, two are white, three purple, and one slightly salmon coloured. The margin is broad and dark coloured.

Unio Cuvierianus. Pl. XVI. Fig. 16.

Testâ lævi, elliptică, convexâ, inequilaterali, posticè obtusè angulatâ; valvulis crassis; natibus prominulis; epidermide nitida, castaneo-fuscâ; dentibus cardinalibus magnis crenulatisque; lateralibus prælongis subcurvisque; margaritâ argentâ.

Shell smooth, elliptical, convex, inequilateral, obtusely angular behind; valves thick; beaks a little prominent; epidermis shining, chestnut-brown; cardinal teeth large, crenulate; lateral teeth very long and somewhat curved; nacre silvery white.

Hab. Washington county, Georgia, Rev. G. White.
Cabinet of Major Le Conte.

Diam. 1.5, Length 2.2, Breadth 3.9 inches.

Shell smooth, elliptical, convex, inequilateral, obtusely angular behind, inflated over the umbones; substance of the shell very thick; beaks but slightly prominent and submedial;

ligament not very long and moderately thick; epidermis chestnut-brown, with very distant marks of growth; posterior slope wide, rather flattened, with two raised lines passing from the beaks to the posterior margin; umbonial slope large and rounded; cardinal teeth large, crenulate, double in the left and single in the right valve; lateral teeth very long, somewhat curved and thickened towards the posterior end, separated from the cardinal tooth; anterior cicatrices large and distinct; posterior cicatrices large and distinct; dorsal cicatrices small, and placed nearly in the centre of the beaks; palleal cicatrix deeply impressed; cavity of the shell wide, not very deep; cavity of the beaks exceedingly small and rounded; nacre silvery white.

Remarks.—A single specimen only of this fine shell has come under my notice, and it belongs to the cabinet of my friend Major Le Conte. It is a member of that great group of which *U. complanatus* is the type, but it differs from that species somewhat in outline, in being inflated over the umbonial slope, and in having a smoother epidermis.

I dedicate this fine species to the memory of the great zoologist, Baron Cuvier.

Unio Forbesianus. Pl. XVI. Fig. 17.

Testâ lævi, triangulari, subcompressâ, inequilaterali, posticè angulatâ; valvulis subcrassis: natibus subprominentibus, ad apices undulatâ; epidermide castaneo-fuscâ; dentibus cardinalibus acuminatis, subgrandibus; lateralibus longis subrectisque; margaritâ vel albâ vel purpureâ et iridescente.

Shell smooth, triangular, rather compressed, inequilateral, angular behind, valves rather thick; beaks rather prominent, undulated at the tip; epidermis chestnut-brown; cardinal teeth rather large and pointed; lateral teeth large and nearly straight; nacre white or purple and iridescent.

Hab. Savannah River. Major Le Conte.

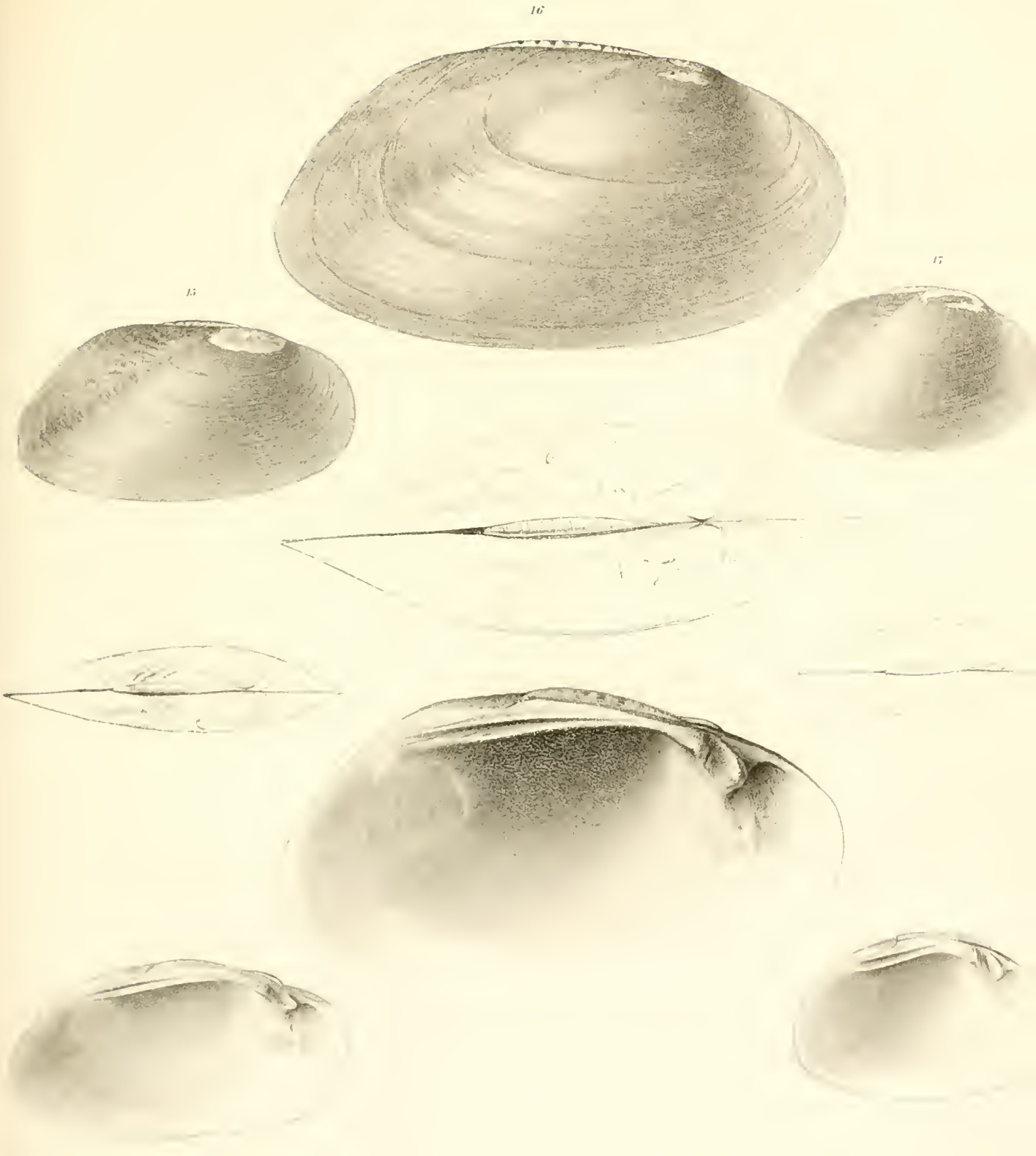
My cabinet and cabinet of Major Le Conte.

Diam. .8, Length 1.2, Breadth 1.8 inches.

Shell smooth, triangular, rather compressed, inequilateral, acutely angular behind, slightly flattened before the umbonial slope; substance of the shell rather thick, thinner behind; beaks rather prominent and rather coarsely undulated at the tip; ligament rather short and moderately thick; epidermis chestnut-brown, lines of growth distant and distinct, sometimes rayed; umbonial slope raised into rather an acute angle; posterior slope flattened and furnished with numerous angular crumpled folds; cardinal teeth rather large, pointed and crenulate; lateral teeth long and nearly straight; anterior cicatrices distinct; posterior cicatrices distinct; dorsal cicatrices placed on the under side of the cardinal teeth; cavity of the shell rather small and rounded; cavity of the beaks shallow and angular; nacre white or purple and iridescent.

Remarks.—Several of these of different ages, were given to me by my friend Major Le Conte, to whom I owe the possession of so many new species. It is allied to *U. incrassatus*, (Nobis,) but is not so transverse. In the young, the epidermis is rather polished, and some of them have greenish rays over the middle of the disk. The smallest of them all is purple in the nacre and beautifully iridescent. Some of the specimens seem to be devoid of rays altogether.

Named in honour of Professor E. Forbes, of King's College, London.



15. Unio fraternus
16. Cuvierianus

Unio Kleinianus. Pl. XVII. Fig. 18.

Testa plicata, triangulari, compressa, ad latere planulatâ, inæquilaterali, posticè obtusè angulatâ: valvulis subcrassis: natibus subprominentibus: epidermide tenebroso-fusca; dentibus cardinalibus crassis crenulatisque; lateralibus brevis rectisque: margaritâ albâ et iridescente.

Shell plicate, triangular, compressed, flattened on the side, inequilateral, obtusely angular behind; valves rather thick; beaks somewhat prominent; epidermis dark-brown; cardinal teeth thick and crenulate; lateral teeth short and straight; nacre white and iridescent.

Hab. Suwanee river, Florida. Major Le Conte.

My cabinet and cabinet of Major Le Conte.

Diam. .8, Length 1.2, Breadth 1.6 inches.

Shell plicate, triangular, compressed, flattened at the side, inequilateral, obtusely angular behind, enlarged over the umbonial slope; substance of the shell rather thick, thinner behind; beaks somewhat prominent; epidermis dark-brown, with marks of growth rather distant; ligament short and thick; folds irregular, small and extending nearly over the whole disk, on the posterior slope more regular and nearly parallel; posterior slope large, and raised into a carina, umbonial slope obtusely angular; cardinal teeth thick, large, crenulate and double in both valves; lateral teeth short and straight, separated from the cardinal tooth by a rather large plate; anterior cicatrices distinct; posterior cicatrices distinct; palleal cicatrix well impressed; cavity of the shell rather deep and rounded; cavity of the beak deep and acutely angular; nacre white and iridescent.

Remarks.—A new plicate species is rather a rare acquisition, and I believe this is the first from Florida. Major Le Conte, I believe, procured but two specimens, both of which are before me. In outline and size it is allied to *U. infucatus*, Con., which, however, is not figured as a folded shell by him. It differs, however, in having larger folds, which are more interrupted, and in the colour of the epidermis, which, in *infucatus*, when old, is almost, if not quite, black. The folds in *Kleinianus* are very irregular, and so much broken up as to have the appearance, on part of the disk, of being nodules. The beaks, unfortunately, of the two specimens are much eroded, and their characters, therefore, not known. I should suppose that, in perfect or young specimens, the folds would extend to the apex, and present a fine appearance.

This interesting species I dedicate to Klein, the author of *Testamen Methodi*, 1773, who was in advance of most of the conchologists of his day.

Unio satur. Pl. XVII. Fig. 19.

Testâ lævi, triangulari, valdè inflatâ, inæquilaterali, posticè truncatâ; valvulis crassis: natibus maximis, inflatis, rotundatis; epidermide tenebroso-fuscâ, politâ: dentibus cardinalibus magnis, compressis, obliquis, acuminatis; crenulatis; lateralibus longis, lamellatis subcurvisque; margaritâ albâ et iridescente.

Shell smooth, triangular, very much inflated, inequilateral, truncate behind; valves thick; beaks large, inflated and rounded; epidermis dark-brown, polished; cardinal teeth large, compressed, oblique, acuminate, crenulate; lateral teeth long, lamellar and curved; nacre white and iridescent.

Hab. Alexandria, Louisiana, J. Hale, M. D. Lake Calcashue, near New Orleans, Mr. Anthony.

My cabinet and cabinets of Dr. Hale and Mr. Anthony.

Diam. 2.1, Length 2.5, Breadth 3 inches.

Shell smooth, triangular, very much inflated, inequilateral, truncate behind; substance of the shell thick, beaks large, inflated, rounded and placed towards the anterior margin; ligament short and very thick; epidermis dark-brown, polished, striate, in the young nearly olive; lines of growth very distant; posterior slope flattened, with an obscure, impressed, rather wide groove from the beaks to the margin; umbonial slope angular towards the beaks and inflated; cardinal teeth large, compressed, oblique, acuminate and crenulate; lateral teeth long, lamellar, curved, enlarged at the posterior end and separated from the cardinal tooth; anterior cicatrices distinct; posterior cicatrices confluent, dorsal cicatrices placed on the under side and near the edge of the plate; palleal cicatrices not deeply impressed; cavity of the shell very deep and rounded; cavity of the beaks very deep and rounded; nacre white and iridescent.

Remarks.—Several specimens of this species have been in my possession for some years. It belongs to the group of which *U. ovatus*, Say, may be considered the type. It is more like *U. occidens*, (Nobis,) than *ovatus*, having the umbonial slope rounded. It differs, however, from the latter species in having a more inflated disk, and in being darker and rounder. It is not so inflated as *capax*, Green, but much like it. All the five individuals before me are females, unless the youngest one. The truncation of the posterior margin is very remarkable. In the oldest specimen, that portion of the disk is so turned in, as to present nearly a flat surface. The beaks are very much inflated and drawn back.

Unio Lamarckianus. Pl. XVII. Fig. 20.

Testâ nodulosâ, subrotundâ, compressâ, in medio planulatâ, subequilaterali, posticè subangulatâ, punctiunculus passim radiatâ; valvulis crassis; natibus prominentibus, compressis, ad apices undulatis; epidermide lutea, virido-radiatâ; radiis numerosis interruptis; dentibus cardinalibus magnis, compressis; lateralibus brevibus crassisque; margaritâ argenteâ.

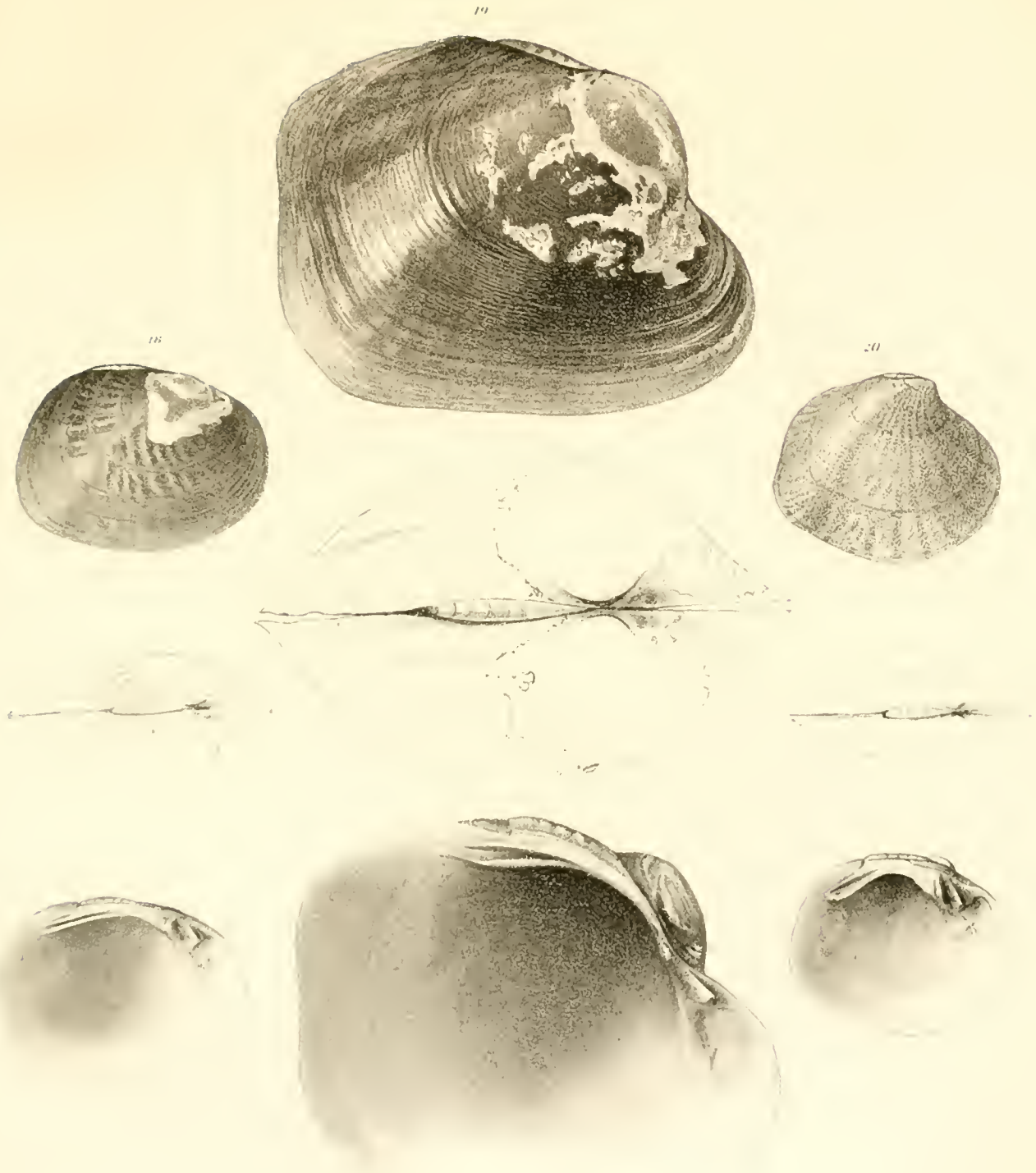
Shell nodulose, subrotund, compressed, flattened in the middle, nearly equilateral, obtusely angular behind, with dotted rays over the whole disk; valves thick; beaks prominent, compressed, and angular at the point; epidermis yellow, with green rays; rays numerous and interrupted; cardinal teeth large, compressed; lateral teeth short and thick; nacre silvery white.

Hab. Caddo river, Arkansas, Professor Powell. Washitta river, near the Hot Springs, Arkansas, Dr. Hale.

My cabinet and cabinets of Prof. Powell and Mr. Shaeffer.

Diam. .5, Length 1.1, Breadth 1.4 inches.

Shell nodulous, subrotund, compressed, flattened from the beak to the basal margin, nearly equilateral, obtusely angular behind, with dotted rays over the whole disk; substance of the shell thinner behind; beaks prominent, compressed and angular at the point; ligament very short and thick; epidermis yellow, with green rays over the whole disk, on the anterior part furnished with a few larger rays; lines of growth distant; rays numerous, interrupted, dotted and chain-like; umbonial slope raised into an obtusely angular ridge from the beaks to the posterior basal margin; cardinal teeth large, compressed, crenulate; lateral teeth short, thick and enlarged at the posterior end; anterior cicatrices distinct; posterior cicatrices distinct, dorsal cicatrices small and placed on the under side



18 Unio Bleekianus
19 solus
20 Lamarckianus

of the cardinal tooth; palleal cicatrices impressed; cavity of the shell very shallow; cavity of the beaks rather deep and angular; nacre silvery white.

Remarks.—The curious and beautiful interrupted rays which cover the whole disk of this species, bring it into the group of which the *U. irroratus*, (Nobis,) was the first described, and may be considered the type. There are now four known, all of which, while easily distinguished, have very much the same general characteristics,—*irroratus*, *dromas*, *caperatus* and *Lamarckianus*. The five specimens before me are of different sizes. The largest is the most perfect one, and is that which is figured. It is about the size of a young *dromas*, when about to finish its two humps. It differs from all the other three species, in having an angular ridge from the beaks to the posterior basal margin. The beaks are remarkably compressed and pointed, like *securis*, (Nobis.) The nodules are little more than rugosities, disposed to run into small folds. Both this and *caperatus* might be said scarcely to belong to the nodulous division of the genus, but they are certainly not devoid of nodules, though they are small and irregular. The lines of growth are very different from *caperatus*. In the latter they are very close. In outline, the *Lamarckianus* is nearly the same with *intermedius*, Con., from Tennessee. It cannot, however, be confounded with that species, as it has not the furrow which that shell has on the posterior slope; nor has it the well expressed verrucose character of it. It differs also in the rays, which in *intermedius* are arrow-head shaped. Indeed the *intermedius* belongs to another group, of which *metanever*, Raf., may be considered the type.

I dedicate this beautiful species to the memory of the great naturalist Lamarck.

Unio hebes. Pl. XVIII. Fig. 21.

Testâ lævi, oblongâ, subcompressâ, ad laterè planulatâ, inæquilaterali, posticè truncatâ: valvulis subcrassis: natibus subprominentibus, ad apices undulatis; epidermide striatâ tenebroso-fuscâ, eradiata; dentibus cardinalibus subcrassis, compressis, obliquis, acuminatis; lateralibus longis curvisque: margaritâ albâ.

Shell smooth, oblong, rather compressed, flattened on the side, inequilateral, truncate behind; valves rather thick; beaks somewhat prominent, undulate at the tip; epidermis striate, dark-brown, rayless; cardinal teeth rather thick, compressed, oblique, acuminate; lateral teeth long and curved; nacre white.

Hab. Oconee river, near Athens, Georgia. Major Le Conte.
My cabinet and cabinet of Major Le Conte.

Diam. .8, Length 1.3, Breadth 2.2 inches.

Shell smooth, oblong, rather compressed, flattened on the side, inequilateral, truncate behind, rounded before; substance of the shell rather thick, beaks somewhat prominent, undulated at the tip and submedial; ligament rather long, thin and nearly covered; epidermis dark brown, without rays, thickly striate over the lower half of the shell, thick and smooth above; lines of growth not well defined; posterior slope compressed into an elevated carina, with a slightly impressed furrow, which has two very obscure raised lines; umbonial slope rounded; cardinal teeth rather thick, compressed, oblique, acuminate, crenulate and double in both valves; lateral teeth long, curved and thickened at the posterior end; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed nearly in the centre of the cavity of the beaks; cavity of the shell shallow and wide; cavity of the beaks shallow and obtusely angular; nacre white.

Remarks.—Among the many shells from Georgia which I owe to the kindness of Major Le Conte, was a single specimen of this species. It is allied to *U. Leconlianus*, (Nobis,) and is like it in outline; but it is more compressed, higher in the carina, and much more striate and rough on the exterior; it is also a thinner shell. The posterior margin of this specimen is also slightly emarginate. The tips of the beaks are not perfect, but they are enough so in this specimen, to show that the undulations are more numerous than usual and very beautiful. The upper portion of the double lateral tooth is very small in this specimen.

Unio Moussonianus. Pl. XVIII. Fig. 22.

Testâ lævi, ellipticâ, subconvexâ, subinequilaterali, posticè angulatâ; valvulis percrassis: natibus prominentibus, crassis; epidermide castanco-fuscâ; dentibus cardinalibus magnis, subcompressis; lateralibus longis, crassis subcurvatus; margaritâ argenteâ et iridescente.

Shell smooth, elliptical, subconvex, subinequilateral, angular before; valves very thick; beaks prominent and thick; epidermis chestnut-brown; cardinal teeth large, rather compressed; lateral teeth long, thick, somewhat curved; nacre silvery white and iridescent.

Hab. Georgia, J. P. Barratt, M. D.

My cabinet and cabinet of Dr. Barratt.

Diam. 1.1, Length 1.8, Breadth 2.8 inches.

Shell smooth, elliptical, subconvex, somewhat inequilateral, angular behind and rounded before; substance of the shell very thick, rather thinner behind; beaks prominent and thick; ligament rather long and thick; epidermis chestnut-brown, marks of growth distant and rather distinct; umbonial slope obtusely angular; cardinal teeth large, rather compressed, double in the left and single in the right valve; lateral teeth long, thick, laminate, thickened towards the posterior end and slightly arched; anterior cicatrices distinct; posterior cicatrices distinct; dorsal cicatrices placed on the under side of the plate, near to the edge; palleal cicatrix impressed; cavity of the shell not very deep; cavity of the beaks rather shallow and angular; nacre silvery white and iridescent.

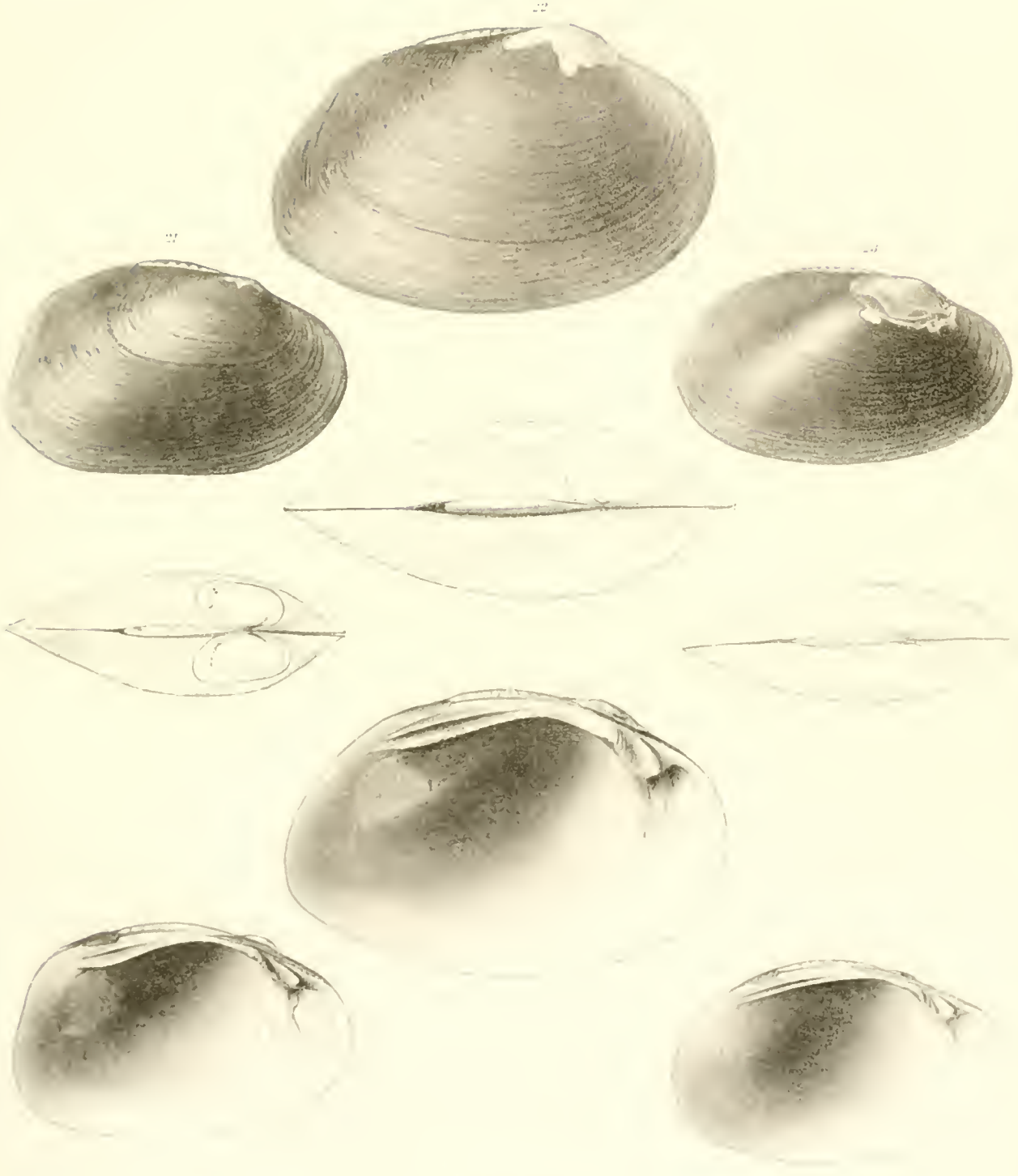
Remarks.—The outline and general appearance of this species reminds one of *U. delodontus*, Lam. It is, however, a thicker shell and has thicker teeth. But three specimens were received by me. One of them is slightly tinged with salmon colour in the cavity of the beaks, and others may be found very likely more deeply coloured.

I dedicate this species to Prof. A. Mousson, of Zurich, the author of "The Land and Fresh Water Shells of Java."

Unio nigerrimus. Pl. XVIII. Fig. 23.

Testâ lævi, elliptica, subconvexâ, inæquilaterali, posticè subrotundatâ; valvulis subtenuibus; natibus parvis, prominulis, ad apices undulatis; epidermide nigrâ, nitidâ, striatâ; dentibus cardinalibus subcompressis, obliquis, acuminatis, crenulatis: lateralibus longis, lamellatis subcurvisque; margaritâ albâ et valdè iridescente.

Shell smooth, elliptical, rather convex, inequilateral, rounded behind; valves rather thin; beaks small, slightly prominent, undulated at the tip; epidermis black, shining, striate; cardinal teeth rather compressed, oblique, acuminate, crenulate; lateral teeth long, lamellar and somewhat curved; nacre white and very iridescent.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23

Hab. Alexandria, Louisiana, J. Hale, M. D.

My cabinet and cabinets of Dr. Hale, and Acad. of Nat. Science.

Diam. .7, Length 1.3, Breadth 2.2 inches.

Shell smooth, elliptical, rather convex, inequilateral, rounded behind; substance of the shell rather thin; beaks small, slightly prominent, undulated at the tip; ligament rather long and thin; epidermis shining, black, striate, in the young radiate all over the disk; marks of growth rather distant; posterior slope compressed into a small carina; umbonial slope slightly raised and rounded; cardinal teeth rather large, somewhat compressed, oblique, acuminate, crenulate and double in both valves; lateral teeth long, lamellar, somewhat curved and separated from the cardinal tooth; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed near the edge of the plate and on the cardinal tooth; cavity of the shell rather shallow; cavity of the beaks shallow and subrotund; nacre white and very iridescent.

Remarks.—This species is nearly allied to *U. Halcianus*, (Nobis,) but differs in the outline, and is not so wide; in the epidermis, which is blacker and more shining, and in the beaks, the undulations of which are more numerous and less regular. It belongs to that group of which *U. Nashvillianus*, (Nobis,) may be considered the type, the beaks being very much, in their undulations, of the character of that species. All the adults, male and female, of which I have many specimens, are very black and apparently without rays, but when held up to a strong light, delicate obscure rays may be observed, particularly about the umbonial slope. In the individuals of one-third growth and less, the epidermis is dark-green and covered with rays. The female differs very much in outline from the male, and is much inflated on that portion of the disk which tends to the posterior basal margin. In this very much enlarged female characteristic, this species resembles *Nashvillianus*, *Halcianus* and *parvus*. This enlargement makes that margin obliquely truncate.

Unio Prevostianus. Pl. XIX. Fig. 21.

Testâ lævi, elliptică, subcompressâ, valdè inequilaterali, posticè rotundatâ; valvulis pertenuibus; natibus parvis, prominulis, ad apices undulatis; epidermide luteâ, tenebroso-radiatâ, politâ; dentibus cardinalibus parvissimus, compressis, perobliquis; lateralibus longis, lamellatis subcurvisque; margarita cæruleâ et iridescente.

Shell smooth, elliptical, rather compressed, very inequilateral, rounded behind; valves very thin; beaks small, slightly prominent, undulated at the tip; epidermis yellow, very much and darkly radiated, polished; cardinal teeth very small, compressed, very oblique; lateral teeth long, lamellar and somewhat curved; nacre bluish and iridescent.

Hab. Eutowah River, Georgia, Mr. C. M. Wheatley.

Cabinet of Mr. Wheatley.

Diam. .7, Length 1.2, Breadth 2.3 inches.

Shell smooth, elliptical, rather compressed, very inequilateral, rounded behind; substance of the shell very thin; beaks small, slightly prominent, undulated at the tip; ligament long and thin; epidermis polished, yellow, with numerous broad dark-green rays covering nearly the whole disk, lighter before and very dark behind, with very distant marks of

growth; posterior slope compressed and raised into a carina and very dark-green; umbonial slope but slightly raised and rounded; cardinal teeth very small, compressed, very oblique, double in both valves; lateral teeth long, lamellar, somewhat curved and abrupt at the posterior end, separated from the cardinal tooth; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed in the cavity of the beaks and on the under side of the plate; palleal cicatrices very indistinct; cavity of the shell rather shallow and rounded; cavity of the beaks shallow and subangular; nacre bluish and beautifully iridescent.

Remarks.—A single specimen only was received by Mr. Wheatley from Georgia. In outline it is very much the same as ***U. radiatus***, but it is a much thinner shell, and in its polish, rays, and thinness allied to ***U. Modioliformis***, (Nobis.) The rays in this specimen are so numerous, broad and dark, as to give the shell quite a tenebrose appearance, almost obliterating the yellowishness of the epidermis.

I name this species after Professor Prevost of Geneva, who, in his able memoir, "De la generation chez les moules des peintres" (*Unio pictorum*) was the first by anatomical demonstration to prove the *Naïades* to be diœcious; it having been previously supposed the male and female organization existed in the same individual. (See Mem. de la Soc. de l'Hist. Nat. de Geneve, March 17, 1825.)

Unio Powellii. Pl. XIX. Fig. 25.

Testâ lævi, elliptieâ, subinflatâ, inæquilaterali, posticè angulatâ: valvulis subtenuibus: natibus subprominentibus: epidermide olivaeeâ, nitidâ, eradiatâ; dentibus cardinalibus parvis, subcompressis, obliquis, acuminatis: lateralibus prælongis subcurvisque: margaritâ albâ et iridescente.

Shell smooth, elliptical, somewhat inflated, inequilateral, angular behind; valves rather thin; beaks rather prominent; epidermis olivaceous, shining, without rays; cardinal teeth small, rather compressed, oblique, acuminate; lateral teeth very long and somewhat curved; nacre white and iridescent.

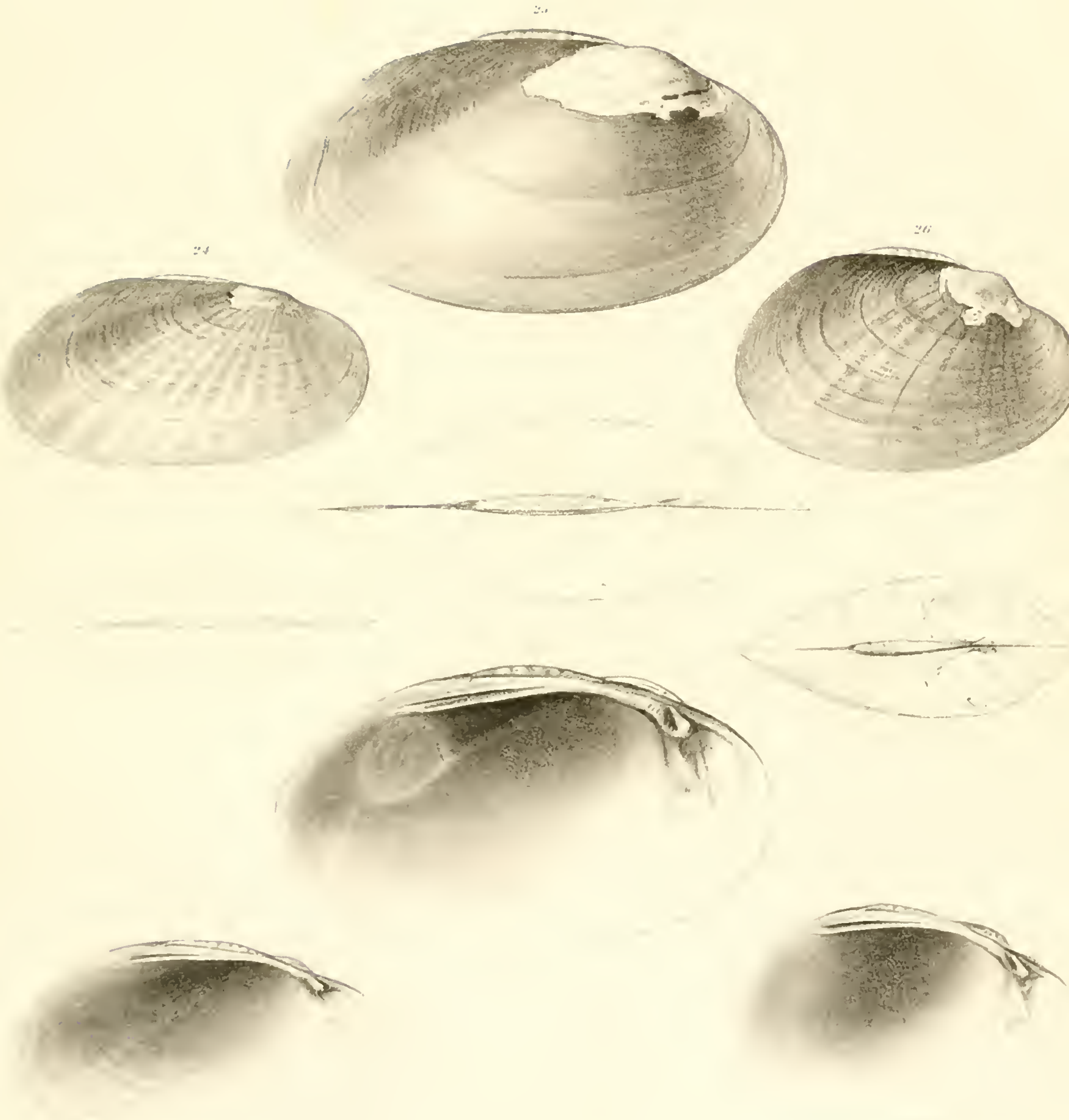
Hab. Saline river, Arkansas, J. Hale, M. D., and Professor Powell.

My cabinet and cabinets of Dr. Hale and Prof. Powell.

Diam. 1.1, Length 1.8, Breadth 3.1 inches.

Shell smooth, elliptical, somewhat inflated, inequilateral, angular behind; substance of the shell rather thin, thicker before; beaks rather prominent and placed towards the anterior margin; ligament long and rather thick; epidermis olivaceous, shining, without rays, with distant, indistinct marks of growth; posterior slope rather depressed, with two slightly impressed lines from the beaks to the posterior margin; umbonial slope subangular; cardinal teeth small, rather compressed, oblique, pointed, crenulate, single in the right and double in the left valve; lateral teeth very long, somewhat lamellar, curved, separated from the cardinal tooth; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed on the under side of the plate between the teeth; palleal cicatrices impressed; cavity of the shell rather deep; cavity of beaks deep and obtusely angular; nacre white and iridescent.

Remarks.—I owe to the kindness of Dr. Hale and Prof. Powell several specimens of this species of both sexes. It belongs to that group of which *cariosus*, Say, may be con-



24 U. [illegible]
25 " Powelli
26 " affinis

sidered the type. In its outline it approaches the *luteolus*, Lam., but is not quite so transverse, while it is more so than *cariosus*. Two of the specimens are richly salmon-coloured in the cavity of the shell—the others are all white. The females are very much enlarged over the umbonial slope, and expanded at the posterior basal margin. None of the specimens which I received have any rays.

I have named this species in honour of Prof. W. Byrd Powell, of Memphis, Tenn.

Unio affinis. Pl. XIX. Fig. 26.

Testâ lævi, ellipticâ, convexâ, inequilaterali, posticè rotundatâ: valvulis subtenuibus: natibus subprominentibus; epidermide radiatâ, luteolâ, nitidâ: dentibus cardinalibus parvis, compressis, obliquis, acuminatis, crenulatis: lateralibus sublongis, lamellatis subcurvisque; margaritâ albâ et iridescente.

Shell smooth, elliptical, convex, inequilateral, rounded behind; valves rather thin; beaks rather prominent, epidermis rayed, yellowish, shining; cardinal teeth small, compressed, oblique, acuminate, crenulate; lateral teeth rather long, lamellar and rather curved; nacre white and iridescent.

Hab. Alexandria, Louisiana, J. Hale, M. D.
My cabinet.

Diam. .9, Length 1.1, Breadth 2.1 inches.

Shell smooth, elliptical, convex, inequilateral, rounded behind and inflated over the umbones; substance of the shell rather thin; beaks rather prominent, placed towards the anterior margin; ligament rather short and somewhat thick; epidermis shining, yellowish, with numerous rays and rather distant marks of growth; posterior slope rather elevated; umbonial slope rounded and inflated; cardinal teeth small, compressed, oblique, acuminate, crenulate, double in both valves; lateral teeth rather long, lamellar, slightly curved, separated from the cardinal tooth; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed across the cavity of the beak under the cardinal tooth; cavity of the shell rather deep and rounded; cavity of the beaks rather shallow and subangular; nacre white and iridescent.

Remarks.—The outline of the specimen before me is of a remarkably regular oval. It belongs to the group of which *cariosus*, Say, may be considered the type. It is nearest in general character to *U. crocatus*, (Nobis,) but it is a larger species, not angular behind, and the rays are broader.

Unio proximus. Pl. XX. Fig. 27.

Testâ lævi, ellipticâ, subinflatâ, subinæquilaterali, posticè rotundatâ: valvulis tenuibus: natibus parvis, subprominentibus; epidermide luteâ, radiatâ: dentibus cardinalibus valdè compressis, obliquis, acuminatis; lateralibus longis, lamellatis subrectisque; margaritâ albâ et iridescente.

Shell smooth, elliptical, somewhat inflated, subinequilateral, rounded behind; valves thin; beaks small, somewhat prominent; epidermis yellowish, radiated; cardinal teeth much compressed, oblique, acuminate; lateral teeth long, lamellar and nearly straight; nacre white and iridescent.

Hab. Georgia. J. P. Barratt, M. D.
My cabinet and cabinet of Dr. Barratt.

Diam. .7, Length 1.2, Breadth 2.1 inches.

Shell smooth, elliptical, somewhat inflated, rather inequilateral, rounded behind; substance of the shell thin; beaks small, slightly prominent; ligament rather short and thin; epidermis yellowish, with rather small, somewhat distant rays on the posterior portion of the disk, and with strong distant marks of growth; posterior slope rather depressed; umbonial slope gradually rounded; cardinal teeth much compressed, oblique, acuminate, double in both valves; lateral teeth thin, rather long, lamellar, nearly straight and separated from the cardinal teeth; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed rather below the centre of the cavity of the beaks; palleal cicatrix impressed anteriorly; cavity of the shell rather deep; cavity of the beaks rounded; nacre white and iridescent.

Remarks.—I have before me but a single specimen of this shell, and with older, younger or more perfect specimens, the characters are very likely to vary. In nearly all its characters it is most nearly allied to *U. obscurus*, (Nobis.) It differs in being less angular at the posterior margin, in being a thinner shell, and in having the teeth lamellar and thin. The colour of this specimen is white, while the *obscurus* is usually partly purplish.

Unio Reeveianus. Pl. XX. Fig. 28.

Testâ lævi, elliptieâ, inflatâ, valdè inequilaterali, posticè obtuso-angulatâ; valvulis tenuibus; natibus parvis, prominulis; epidermide luteâ, radiatâ; dentibus cardinalibus parvis, subobliquis; lateralibus longis, tenuibus subcurvisque; margarita alba et iridescente.

Shell smooth, elliptical, inflated, very inequilateral, obtusely angular behind; valves thin; beaks small, a little prominent; epidermis yellowish, radiated; cardinal teeth small, rather oblique; lateral teeth long, thin and curved; nacre white and iridescent.

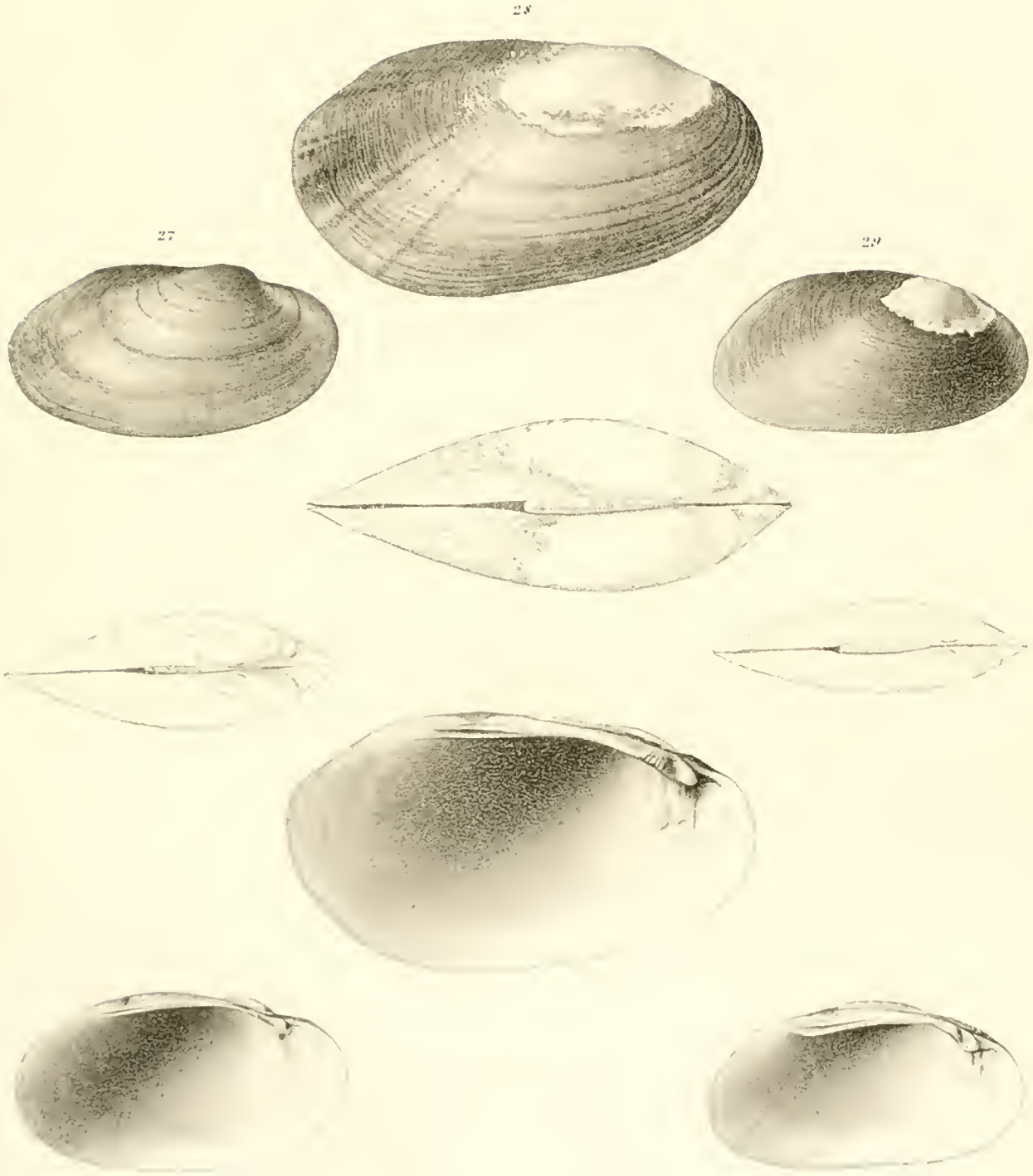
Hab. Alexandria, Louisiana, J. Hale, M. D., and Prof. Powell.

My cabinet and cabinets of Dr. Hale and Prof. Powell.

Diam. 1.1, Length 1.6, Breadth 2.9 inches.

Shell smooth, elliptical, inflated, very inequilateral, obtusely angular behind; substance of the shell thin, thicker before; beaks small and a little prominent; ligament rather long and somewhat thick; epidermis yellowish, shining, with numerous green rays over the posterior portion of the shell and distant lines of growth; posterior slope rather compressed into a carina; umbonial slope but slightly raised and rounded; cardinal teeth small, rather oblique, double in the right and slightly double in the left valve; lateral teeth long, thin, somewhat curved, widely separated from the cardinal teeth; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed on the under side of the plate; palleal cicatrix impressed; cavity of the shell deep; cavity of the beaks rather shallow and subangular; nacre white and iridescent.

Remarks.—Among the many interesting shells sent to me by Dr. Hale and Prof. Powell, were two specimens which are now before me. The larger one, which is here figured, is apparently a male, the other a female. They differ much, the latter being much smaller, but apparently grown. It is very much broader on the posterior portion, and somewhat truncate. In colour and form of rays the two specimens are the same. Neither of them are by any means perfect, being much eroded towards the beaks, the character of which,



27 Uno proximus
28 Rexianus
29 luridus

in regard to undulations, cannot be ascertained. In general outline and characteristics, it is allied to *U. luteolus*, Lam. It is, however, thinner and lighter in the substance of the shell, and the rays are not so broad. The teeth, too, are smaller, and the lateral are much more removed from the cardinal ones. In the two specimens before me the division of the lateral teeth is remarkably short, not reaching more than half the length of the tooth.

I dedicate this species to Lovell Reeve, Esq., the able author of "Conchologia Iconica."

Unio luridus. Pl. XX. Fig. 29.

Testâ lævi, ellipticâ, compressâ, valdè inæquilaterali, posticè subbiangulatâ; valvulis subcrassis; natibus parvis, vix prominulis; epidermide tenebroso-bruncâ, striatâ, eradiatâ; dentibus cardinalibus parvis, acuminatis; lateralibus longis curvisque; margaritâ vel cæruleâ-albâ vel salmonis colore tinctâ.

Shell smooth, elliptical, compressed, very inequilateral, subbiangular behind; valves somewhat thick; beaks small, scarcely prominent; epidermis dark-brown, striate, without rays; cardinal teeth small, acuminate; lateral teeth long and curved; nacre bluish-white or salmon-coloured.

Hab. Coosawattee river, Murray county, Georgia, Dr. Boykin.
My cabinet.

Diam. .6, Length 1, Breadth 2 inches.

Shell smooth, elliptical, compressed, very inequilateral, subbiangular behind; substance of the shell somewhat thick; beaks small, scarcely prominent, placed towards the anterior margin; ligament rather long and thin; epidermis dark-brown, striate, without any apparent rays, with rather distant marks of growth; posterior slope rather compressed; umbonial slope very slightly raised into a scarcely visible angle; cardinal teeth small, acuminate, double in the left and single in the right valve; lateral teeth long, curved and enlarged at the posterior end; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed above the centre of the cavity of the beaks; palleal cicatrices slightly impressed; cavity of the shell very shallow; cavity of the beaks exceedingly shallow and rounded; nacre bluish-white and salmon coloured.

Remarks.—Some half dozen of this small, unattractive species I owe to the kindness of my late friend, Dr. Boykin. Two of them are slightly salmon coloured, the others are bluish-white. It is somewhat like *U. complanatus;* but, in outline, it is more like *occultus*, (Nobis,) the beak is more terminal than in either, and the whole appearance of the shell reminds one of *U. arctior*, (Nobis,) but it is not so wide a shell. Several of the specimens are not so dark a brown as the others, but are inclined to dark-olive.

Unio Clarkianus. Pl. XXI. Fig. 30.

Testâ lævi, ellipticâ, convexâ, ad umbonis inflatâ, inequilaterali, posticè angulatâ; valvulis crassis; natibus subprominentibus, subrotundis; epidermide rufo-fuscâ, nitidâ; dentibus cardinalibus subcrassis, acuminatis, granulatis; lateralibus subbrevibus, crassis, arcuatis; margaritâ vel albâ vel salmonis colore tinctâ et iridescente.

Shell smooth, elliptical, convex, on the umbones inflated, inequilateral, angular behind; valves thick; beaks rather prominent, subrotund; epidermis reddish-brown, shining; cardinal teeth rather thick, acuminate, granular; lateral teeth rather short, thick and arched; nacre white or salmon coloured and iridescent.

Hab. Williamsport, Tenn., Mr. Jos. Clark; Georgia or Alabama, Mr. C. M. Wheatley.
My cabinet and cabinets of Mr. Clark and Mr. Wheatley.

Diam. 1, Length 1.4, Breadth 2.2 inches.

Shell smooth, elliptical, convex, on the umbones inflated, inequilateral, angular behind; substance of the shell thick, thinner behind; beaks rather prominent, subrotund, submedial; ligament short and thick; epidermis reddish-brown, shining, with rather close, distinct marks of growth; posterior slope wide, and rather depressed; umbonial slope very obtusely angular; cardinal teeth rather thick, acuminate, granular, single in the right and double in the left valve; lateral teeth rather short, thick, arched, thicker towards the posterior end, separated from the cardinal teeth; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed nearly in the centre of the cavity of the beaks; cavity of the shell deep and rounded; cavity of the beaks deep and angular; nacre white or salmon-coloured.

Remarks.—There are two specimens before me of nearly the same size; that from Williamsport is slightly salmon-coloured in the cavity of the shell, and has rays over nearly the whole disk. The other has no rays whatever. This species is allied to *U. crocatus*, (Nobis,) but is a larger, thicker and more regularly oval shell.

I name it in honour of my friend Mr Joseph Clark, of Cincinnati.

Unio Floridensis. Pl. XXI. Fig. 31.

Testâ lævi, obovatâ, subtransversâ, subcompressâ, valdè inæquilaterali, anticè angustâ, posticè sublatâ; valvulis tenuibus; natibus prominulis, fere terminalibus; dentibus cardinalibus parvis; lateralibus longis subcurvisque; margaritâ albâ.

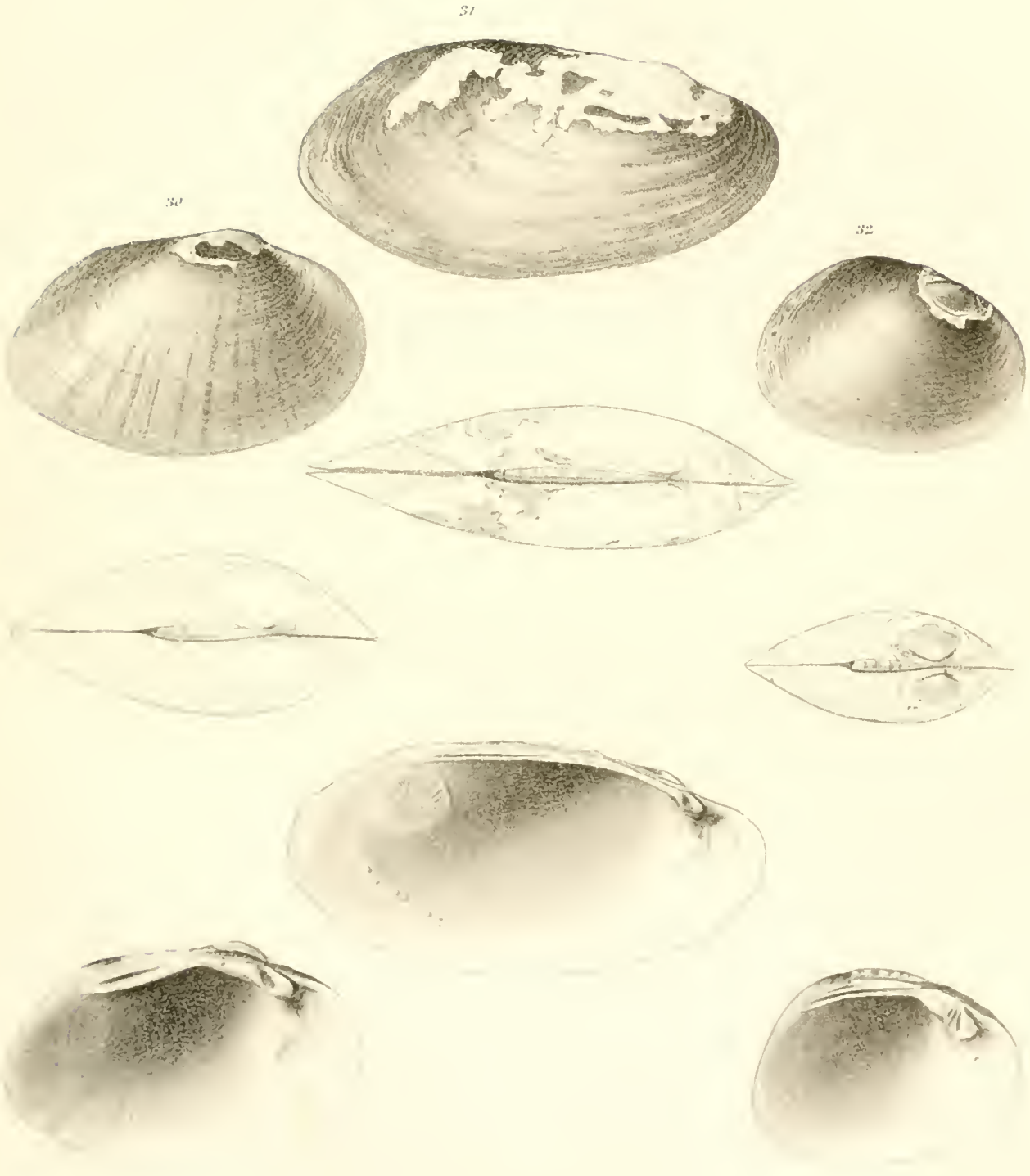
Shell obovate, rather wide, somewhat compressed, very inequilateral, narrow before and rather broad behind; valves thin; beaks somewhat prominent, nearly terminal; cardinal teeth small; lateral teeth long and slightly curved; nacre white.

Hab. Chácktáhachi river, West Florida, Major Le Conte.
Cabinet of Major Le Conte.

Diam. .9, Length 1.5, Breadth 3 inches.

Shell reversely ovate, transverse, rather compressed, very inequilateral, narrow before and broad behind; substance of the shell thin, thickened before; beaks rather small and somewhat prominent; placed near to the anterior margin; ligament long and rather thick; epidermis light-yellow, with equal, somewhat distant lines of growth, apparently without rays; cardinal teeth very small, lobed, double in both valves; lateral teeth very long, very thin, and slightly curved; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed in the centre of the cavity of the beaks; cavity of the shell rather shallow; cavity of the beaks shallow and subangular; nacre white.

Remarks.—This is a species very distinct from any which I have seen. Its obovate form, while it is so wide, is very unusual. It cannot be confounded with *U. modioliformis*, (Nobis,) which is a thinner shell, rayed and much inflated. The teeth are remarkably small, for the size of the shell, and the lateral one particularly attenuate. The epidermis is of the yellow colour and texture peculiar to *U. anadontoides*, (Nobis,) and *U. cariosus*, Say.



30 Unio Clarkianus
31 " Floridensis
32 " succissus

A single specimen only is under my inspection, and this is much eroded on the superior portion, leaving only false beaks. It is not, of course, possible to say whether the tips are undulate or not.

Unio succissus. Pl. XXI. Fig. 32.

Testâ lævi, subtriangulari, subcompressâ, inæquilaterali, tenebroso-fuscâ; valvulis subcrassis: natibus subprominentibus: dentibus cardinalibus magnis; lateralibus parvis subrectisque: margaritâ purpureâ et valdè iridescente.

Shell smooth, subtriangular, rather compressed, inequilateral, dark-brown; valves rather thick; beaks somewhat prominent; cardinal teeth large; lateral teeth nearly straight; nacre purple and very iridescent.

Hab. West Florida, Major Le Conte.

My cabinet and cabinets of Major Le Conte and Prof. Haldeman.

Diam. .7, Length 1.2, Breadth 1.7 inches.

Shell smooth, subtriangular, rather compressed, inequilateral, subangular behind and rounded before, subangular on the umbonial slope, dark-brown; beaks somewhat prominent and placed near the anterior margin; ligament very short and rather thin; epidermis dark-brown, with indistinct, rather distant lines of growth, smooth on the superior portion, striate and rather rough towards the margin, apparently without rays; cardinal teeth large, rather erect, double in both valves; lateral teeth rather short, thin, and very slightly curved; anterior cicatrices distinct; posterior cicatrices distinct; dorsal cicatrices placed on the inferior portion of the cardinal teeth, within the cavity of the beaks; cavity of the shell rather shallow; cavity of the beaks deep and angular; nacre purple, somewhat clouded, and very iridescent.

Remarks.—A single specimen of this species was sent to me by Major Le Conte. The beaks, being eroded, do not present the means of ascertaining if this be undulate at the tip. The general outline approaches very closely to *U. rubiginosus*, (Nobis,) but it is rather more carinate on the posterior slope, and more compressed on the anterior portion of the shell. It differs entirely from that species in its nacre, belonging, in regard to colour, to the *complanatus* group, which varies so much in purple, white and salmon. The specimens before me are not of a deep purple, but rather pale, and clouded with white. The margin and teeth are the darkest. In other individuals the colour may be found to vary from dark-purple to white.*

Prof. Haldeman's specimen is less triangular. It also came from Major Le Conte.

Unio Oregonensis. Pl. XXII. Fig. 33.

Testâ lævi, elliptică, subinflatâ, subinæquilaterali, posticè obtusè angulatâ; valvulis crassis; natibus subprominentibus: epidermide tenebroso-olivaceâ, rugosâ, valdè striatâ, obsoletè radiatâ; dentibus cardinalibus magnis, obliquis, compressis et valdè crenulatâ; lateralibus longis, subcrassis curvatisque; margaritâ albâ et iridescente.

* Since the above was written, I have seen, in Mr. Wheatley's collection, two specimens from New Orleans, both of which are white.

Shell smooth, elliptical, somewhat inflated, inequilateral, obtusely angular behind; valves thick, beaks somewhat prominent; epidermis dark-olive, rough, very much striate, obsoletely radiated; cardinal teeth large, oblique, compressed and much crenulated; lateral teeth long, rather thick and curved; nacre white and iridescent.

Hab. Columbia river, Oregon, Mr. C. M. Wheatley.

Diam. .8, Length 1.2, Breadth 2.1 inches.

Shell smooth, elliptical, somewhat inflated, inequilateral, obtusely angular behind; substance of the shell thick, thinner behind; beaks somewhat prominent, submedial; ligament rather short and somewhat thick; epidermis dark-olive, very rough, and striate over the whole disk, with very obscure, rather thin rays; posterior slope somewhat compressed; umbonial slope obtusely angular; cardinal teeth large, oblique, compressed and much crenulated, double in the left and single in the right valve; lateral teeth long, rather thick, curved, enlarged at the posterior end and separated from the cardinal tooth; anterior cicatrices distinct; posterior cicatrices distinct; dorsal cicatrices placed obliquely on the inner portion of the cardinal tooth and under the plate; palleal cicatrix impressed; cavity of the shell rather shallow; cavity of the beaks shallow and subangular; nacre white and iridescent.

Remarks.—I owe to the kindness of Mr. Wheatley one of the two specimens before me. It is a species very distinct from any I am acquainted with. The roughness of the exterior is remarkable, and would indicate its inhabiting near to brackish waters. It is not usual to see a rough shell like this with rays. In those specimens which are eroded and old, they are indistinct; but I suspect that when perfect the rays might be very distinct. In outline, it is somewhat like a young *U. ligamentinus*, Lam., (*crassus*, Say,) and the nacre is of the same pure white, but the surface is totally different, being rough, and the form more transverse. In its elliptical outline it comes closer to *U. Sapotalensis*, (Nobis,) but is a smaller shell, and differs much in the rays and the surface.

Unio Rumphianus. Pl. XXII. Fig. 34.

Testâ tuberculatâ, quadratâ, subinflatâ, subinæquilaterali, postice truncatâ, ad basim emarginatâ; valvulis pererassis; natibus crassis, prominentibus; epidermide rufo-fuscâ, substriatâ; dentibus cardinalibus pererassis striatisque; lateralibus brevibus rectisque; margaritâ argenteâ et iridescente.

Shell tuberculate, quadrate, somewhat inflated, rather inequilateral, truncate behind, emarginate at the basal margin; valves very thick; beaks thick and prominent; epidermis reddish-brown, substriate; cardinal teeth very thick and striate; lateral teeth short and straight; nacre silver white and iridescent.

Hab. West Georgia? Dr. Budd.

Cabinet of Dr. Budd, New York.

Diam. 1.1, Length 1.7, Breadth 2 inches.

Shell tuberculate, quadrate, somewhat inflated, rather inequilateral, truncate behind, emarginate at the basal margin, raised over the umbonial slope and grooved from beaks to basal margin; substance of the shell very thick, thinner behind; beaks thick, submedial and prominent; ligament short and thick; epidermis reddish-brown, somewhat striate, with distinct, proximate marks of growth; posterior slope compressed, raised into a carina and covered with curved rows of tubercles; umbonial slope raised into a widening ridge,

which enlarges the posterior basal margin; cardinal teeth very large, thick, spread out, and deeply striate; lateral teeth short, thick, straight, with a large, flat plate separating them from the cardinal teeth; anterior cicatrices distinct and deeply impressed; posterior cicatrices confluent; dorsal cicatrices placed on the inner side of the plate; palleal cicatrix impressed; cavity of the shell rather deep and small; cavity of the beaks very deep and angular; nacre silvery white and iridescent.

Remarks.—A single valve only was in the collection of Dr. Budd, and he thinks it came from the west of Georgia. I have had it in my possession for several years, and deferred describing it in the hope of getting more specimens; but in comparing it with its allied species, *melanever*, Raf., *tuberosus*, (Nobis,) and *sparsis*, (Nobis,) I have found it too different in outline and some other characters to place it with either. It is much more enlarged on the posterior slope, which is almost winged, and it is without a groove on that part, which the other three have. In this specimen the groove over the middle of the valve is deeper than in the other species. The anterior portion is more enlarged than in the others, and it has many rather low tubercles, the general character of which, over the whole disk, is rather depressed and smooth. In the *tuberosus* and *melanever* the tubercles are generally more raised and roughened. The tubercles on the posterior slope in this specimen arrange themselves in curved rows, which, running to the margin, make it crenulate.

The lateral teeth are remarkably short, straight, and very thick. The intervening plate between the cardinal and lateral teeth is exceedingly large and very flat.

I dedicate this species to the memory of Rumphius, the author of "D'Amboinsche Rariteitkamer."

Unio sagittiformis. Pl. XXII. Fig. 35.

Testâ lævi, valdè transversâ, compressâ, ad latere planulatâ, valdè inæquilaterali, posticè acutè angulatâ; valvulis subtenuibus: natibus parvis, prominulis, ad apices undulatis: epidermide virido-fuscâ, radiatâ: dentibus cardinalibus parvis, compressis, crenulatis; lateralibus prælongis subrectisque; margaritâ purpureâ et iridescente.

Shell smooth, very wide, compressed, flattened at the side, very inequilateral, acutely angular behind; valves rather thin; beaks small, slightly prominent, undulated at the tip; epidermis greenish-brown, rayed; cardinal teeth small, compressed, crenulate; lateral teeth very long and nearly straight; nacre purple and iridescent.

Hab. Oconee river, near Athens, Georgia, Major Le Conte.

My cabinet and cabinet of Major Le Conte.

Diam. .6, Length 1.2, Breadth 2.7 inches.

Shell smooth, very wide, compressed, flattened at the side, very inequilateral, acutely angular behind; substance of the shell thin; beaks small, slightly prominent, undulated at the tip and placed towards the anterior margin; ligament long and thin; epidermis brownish, with numerous broad, dark-green rays, covering the whole disk, with rather distant lines of growth; posterior slope somewhat compressed, with a single raised line passing from the beak to the posterior margin; umbonial slope rather acutely angular; cardinal teeth rather small, compressed, crenulate, double in both valves; lateral teeth long, nearly

straight, and thickened at the posterior end; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed nearly in the centre of the cavity of the beaks; palleal cicatrix impressed; cavity of the shell very shallow; cavity of the beaks shallow and rounded; nacre purple and iridescent.

Remarks.—I have before me two specimens of this species, which belongs to the group of which the *U. nasalus*, Say, may be considered the type. Its form and appearance is altogether graceful. It perhaps more closely resembles *Fisherianus*, (Nobis,) than any other species, but may be distinguished in being rather less wide, and it differs in having broader rays. In outline, it resembles *U. Barrallianus*, (Nobis,) but it is a wider shell, and not so thick. The two specimens I have are both of a fine purple; others may differ, and it may be found white and salmon colour.

Unio Stewardsonii. Pl. XXIII. Fig. 36.

Testâ lævi, triangulari, compressâ, inæquilaterali, posticè emarginatâ, ad basim prælongâ, ad latcrè planulatâ; valvulis crassis; natibus prominulis; epidermide luteo-fuscâ, radiatâ; dentibus cardinalibus subcrassis, crenulatis; lateralibus brevissimis, crassis, crenulatis rectisque; margaritâ argenteâ et irideseente.

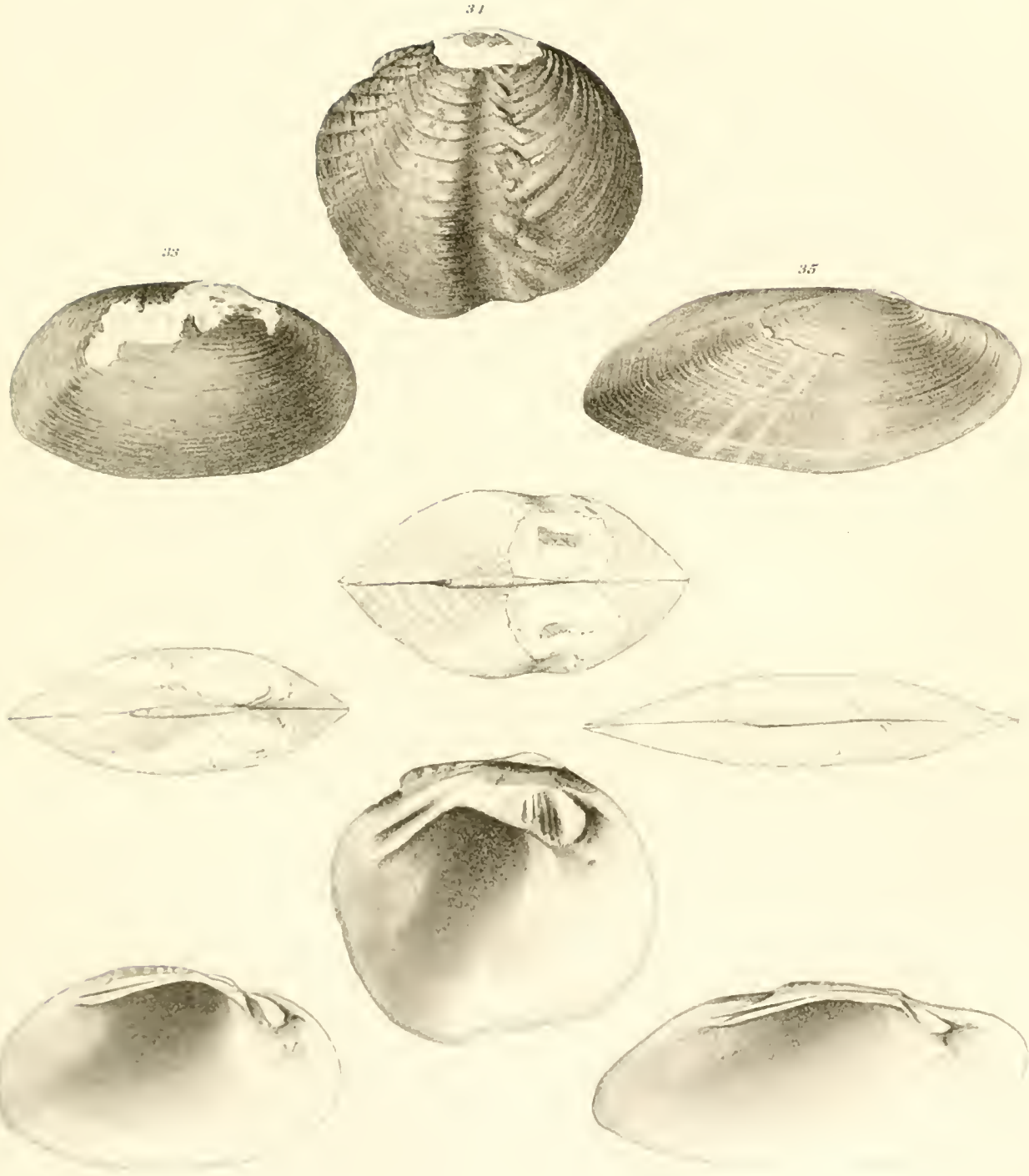
Shell smooth, triangular, compressed, inequilateral, emarginate behind, prolonged at the base and flattened at the side; valves thick; beaks rather prominent; epidermis yellowish-brown, radiated; cardinal teeth rather thick, crenulate; lateral teeth very short, thick and straight; nacre silvery white and iridescent.

Hab. Chatanooga river, Tenn., Thomas Stewardson, M. D.
Cabinet of the Academy of Natural Sciences.

Diam. .6, Length 1, Breadth 1.2 inches.

Shell smooth, triangular, compressed, inequilateral, emarginate behind, enlarged and extended circularly at the base, flattened at the side; substance of the shell thick, thinner behind; beaks rather prominent; ligament short and rather thin; epidermis yellowish dull-brown, with numerous capillary rays over most of the disk, and with distant marks of growth; posterior slope flattened and lighter in colour; umbonial slope obtusely angular; cardinal teeth rather thick, crenulate, double in both valves; lateral teeth very short, crenulate, thick, nearly straight, and thickened at the posterior end; anterior cicatrices distinct; posterior cicatrices distinct; dorsal cicatrices placed near to the margin and almost in connexion with the cardinal tooth; palleal cicatrix impressed; cavity of the shell very shallow; cavity of the beaks shallow and subangular; nacre silvery white and iridescent.

Remarks.—Among many interesting specimens of some twenty species, brought by Dr. Stewardson, was a single specimen of this species. It is very closely allied to the *Unio foliatus*, Hild., and at first I did not hesitate to consider it as a small specimen of the female of that species, but a very slight examination of the enlargement of that portion of the shell which indicates the female character, satisfied me that it could not be the same. In the *foliatus* the enlargement for the oviducts is always a continuation and enlargement of the ridge over the middle of the disk; and immediately before this there is, in the mature female, a deep indentation. In the *Stewardsonii* this emarginate part is replaced by *the enlargement*, and instead of being indented at the posterior basal margin,



33 Unio Oregonensis
34 " Rhamphaenus
35 " sagittiformis.

it really is there enlarged. The position, therefore, of the oviducts of the animal, which I have not seen, must be different. Judging from this single specimen, I should think it will prove to be a much smaller species than the *foliatus* of the Ohio.

I name it after Dr. Stewardson, to whose exertions we are indebted for its discovery.

Unio Hanleyianus. Pl. XXIII. Fig. 37.

Testâ lævi, obliquâ, tumidâ, valdè inæquilaterali, posticè angulatâ; valvulis percrassis; natibus grandibus, tumidis; epidermide bruneo-olivâ, striatâ, eradiatâ; dentibus cardinalibus parvis, pyramidatis; lateralibus brevis rectisque; margaritâ albâ et iridescente.

Shell smooth, oblique, swollen, very inequilateral, angular behind; valves very thick; beaks large and swollen; epidermis brownish-olive, striate, without rays; cardinal teeth small, pyramidal; lateral teeth short and straight; nacre white and irideseent.

Hab. Coosawattee river, Murray county, Georgia. Dr. Boykin.
My cabinet.

Diam. .8, Length .9, Breadth 1.4 inches.

Shell smooth, oblique, swollen, very inequivalve, angular behind; substance of the shell very thick, much thinner behind; beaks large, swollen and placed towards the anterior margin; ligament short and thin; epidermis brownish-olive, striate, without rays and with close marks of growth; posterior slope wide and rather depressed; umbonial slope raised, very obtusely angular; cardinal teeth small, pyramidal, single in the right, and double in the left valve; lateral teeth short, straight and in a direction much above the cardinal tooth; anterior cicatrices distinct and deeply impressed; posterior cicatrices distinct; dorsal cicatrices on the under side of the plate; palleal cicatrix impressed; cavity of the shell deep and irregularly oval; cavity of the shell shallow and obtusely angular; nacre white and iridescent.

Remarks.—Three or four specimens are before me, differing very little from each other. The marks of growth are unusually close together, and are much darker than the interspace, which is brownish-olive. It is a pretty little species, and is allied to *U. decisus*, (Nobis,) and *scalenius*, Raf., and approaches *U. pulvinulus*, (Nobis.) It differs from the first in not having the beaks so terminal, and not being so much swollen on the anterior portion of the disk; from the second, in not having the beaks so terminal, in being more oval and in being without rays. From the last it differs in being less rounded, of a lighter colour, and having the marks of growth closer.

I dedicate this species to Sylvanus Hanley, Esq., one of the authors of "History of British Mollusca, &c."

Unio placitus. Pl. XXIII. Fig. 38.

Testâ lævi, elliptică, subinflatâ, inæquilaterali, posticè subangulatâ; valvulis subcrassis; natibus subprominentibus, rotundatis; epidermide castaneâ, nitidâ, obsolete radiatâ; dentibus cardinalibus subparvis, compressis, per obliquis, crenulatis; lateralibus sublongis, lamellatis curvisque; margaritâ salmonis colore tinctâ.

Shell smooth, elliptical, rather inflated, inequilateral, subangular behind; valves a little thick; beaks somewhat prominent, rounded; epidermis chestnut-coloured, shining, obsoletely rayed; cardinal teeth rather small, compressed, very oblique, crenulate; lateral teeth rather long, lamellar and curved; nacre salmon coloured.

Hab. Alabama, Mr. C. M. Wheatley.
Cabinet of Mr. Wheatley.

Diam. .5, Length .8, Breadth 1.3 inches.

Shell smooth, elliptical, rather inflated, inequilateral, angular behind; substance of the shell a little thick; beaks somewhat prominent, rounded, ligament short and thin; epidermis chestnut-coloured, shining, obsoletely rayed, with rather distant marks of growth; posterior slope rather depressed; umbonial slope slightly raised and round, cardinal teeth rather small, compressed, very oblique, crenulate and double in both valves; lateral teeth rather long, lamellar, curved and separated from the cardinal teeth; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed on the under side of the plate; cavity of the shell rather deep and regularly oval; cavity of the beaks small and subangular; nacre salmon coloured.

Remarks.—This is a small, regular and pretty-looking shell, of which only one specimen was in Mr. Wheatley's collection. I could not place it in any species known to me. It may not be a fully grown specimen. It is nearest in outline to *U. constrictus*, Con., in those specimens where the margin is not constricted, which is often the case. It differs from it in being a thicker shell, more regularly oval, and being fuller on the umbones and on the umbonial slope. In the rays it also differs, having fewer, and these being more distant. It is also rounder on the posterior margin. The nacre of the specimen before me is of a pale salmon colour, inclining to rose. Other specimens will be likely to vary in colour.

Unio Troschelianus. Pl. XXIII. Fig. 39.

Testâ lævi, subobliquâ, convexiusculâ, inæquilaterali, posticè subangulatâ; valvulis crassis; natibus subgrandibus; epidermide brunneo-olivâ, striatâ, radiatâ; dentibus cardinalibus parvis, granulatis; lateralibus brevis, crassis rectisque; margaritâ albâ et iridescente.

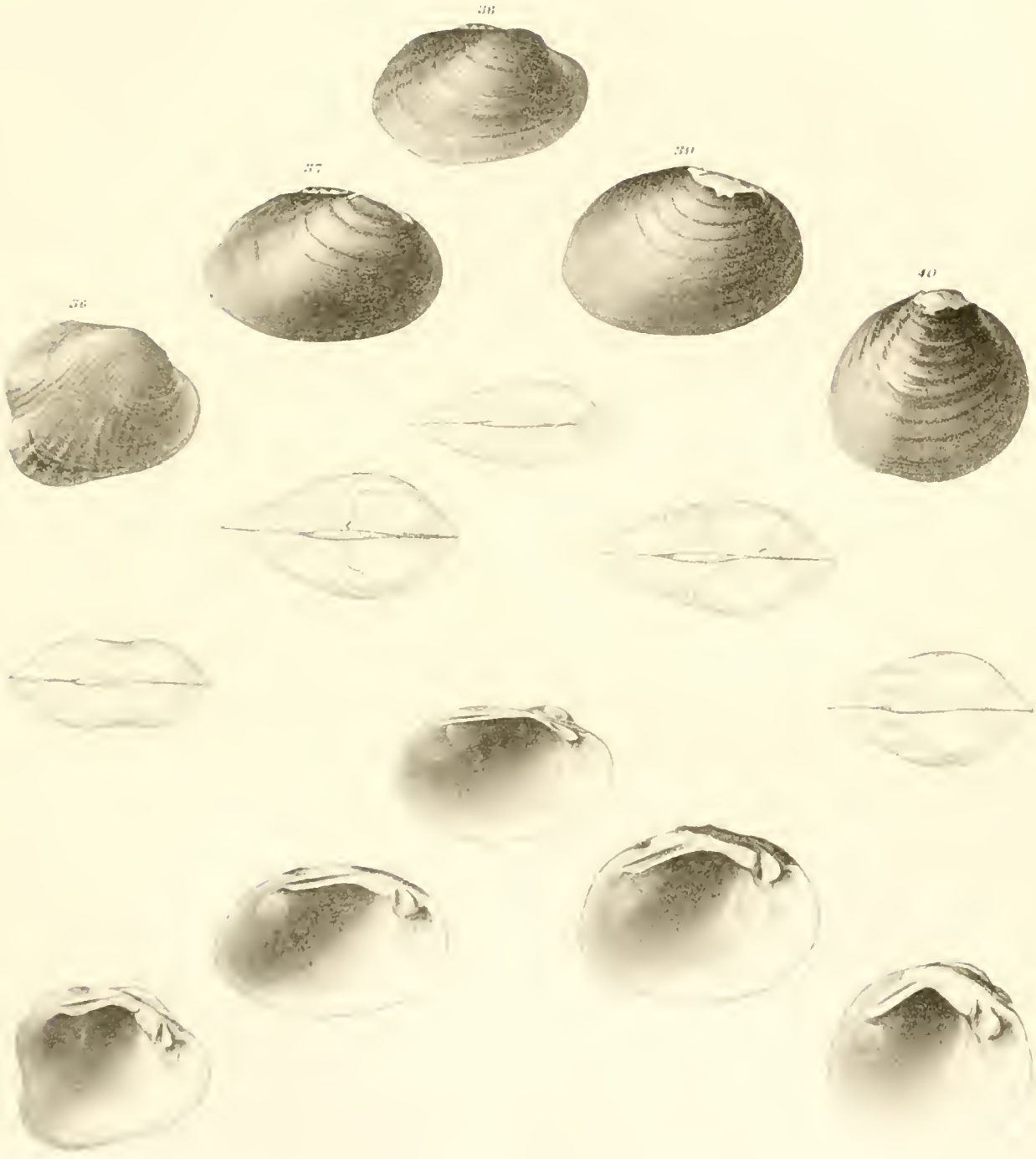
Shell smooth, suboblique, somewhat convex, inequilateral, subangular behind; valves thick; beaks rather large; epidermis brownish-olive, striate, without rays; cardinal teeth small, granulate; lateral teeth short, thick and straight; nacre white and iridescent.

Hab. Coosawattee river, Murray county, Georgia, Dr. Boykin.
My cabinet.

Diam. .7, Length 1.1, Breadth 1.5 inches.

Shell smooth, rather oblique, somewhat convex, inequilateral, subangular behind, rounded before; substance of the shell thick, thinner behind; beaks rather large, submedial; ligament rather short and thin; epidermis brownish-olive, striate, without rays, and with very close marks of growth; posterior slope somewhat compressed; umbonial slope rounded; cardinal teeth small, granulate, single in the right and double in the left valve; lateral teeth short, thick and straight; anterior cicatrices distinct, posterior cicatrices distinct; dorsal cicatrices placed on the under side of the plate; palleal cicatrix well impressed; cavity of the shell rather shallow and rounded; cavity of the beaks very shallow and obtusely angular; nacre white and iridescent.

Remarks.—Several specimens are before me, neither of which have perfect beaks.



36 Unio Stewardsonii
37 Hanleyanus
38 placitus
39 Troschelianus
40 Kemerianus

Whether there be undulations at the tips it is impossible to say. In outline, it is somewhat like *U. Ravenelianus*, (Nobis,) but it is less oblique and less compressed. It is also allied to *U. nucleopsis*, Con., but that is quite round in the outline, while the former is rather oblique. It is also much more compressed.

I dedicate this species to M. Troschel, who has done much in the anatomy of this family.

Unio Keinerianus. Pl. XXIII. Fig. 40.

Testâ tuberculatâ, subrotundatâ, subinflatâ, subequilaterali; valvulis crassis; natibus prominentibus, submedialis; epidermide luteolâ, substriatâ; dentibus cardinalibus grandibus, granulatis crassisque; lateralibus brevis, crassis subrectisque; margaritâ albâ et iridescente.

Shell tuberculate, subrotund, somewhat inflated, subequilateral; valves thick, beaks prominent, submedial; epidermis yellowish, somewhat striate; cardinal teeth large, granulate and thick; lateral teeth short, thick and nearly straight; nacre white and iridescent.

Hab. Coosawattee river, Murray county, Georgia, Dr. Boykin.
My cabinet.

Diam. .7, Length 1.1, Breadth 1.3 inches.

Shell sparsely tuberculate, subrotund, somewhat inflated, nearly equilateral, rounded behind; substance of the shell thick, rather thinner behind; ligament short and rather thick; epidermis yellowish, somewhat striate near the margin, with very close marks of growth; posterior slope wide and but slightly raised; umbonial slope rounded; cardinal teeth large, granulate, thick, double in the left and somewhat trifid in the right valve; lateral teeth short, thick, nearly straight, far removed from, and in a direction far above the cardinal tooth, leaving a large plate between the two teeth; anterior cicatrices distinct; posterior cicatrices distinct; dorsal cicatrices in a row under the cardinal teeth; palleal cicatrix well impressed; cavity of the shell moderately deep; cavity of the beaks deep and angular; nacre white and iridescent.

Remarks.—I very much regret that I have not better specimens of this species. The four before me are all worn in the beaks more or less, and two of them are quite old and eroded. The two younger ones only have rays. The older of these, here figured, has a broad, green ray over the middle and anterior portion of the disk, and two small ones on the posterior slope. On the youngest specimen, about one-fourth grown, there is no tubercle; on the others they are very few and very small, and placed towards the margin. These are so small as scarcely to deserve the name. This species belongs to the group of which *U. pustulosus*, (Nobis,) may be considered the type. It differs from that shell in being rounder and having fewer tubercles, in being less angular behind and more rounded before. It is allied to *U. Schoolcraftensis*, (Nobis,) but that is more quadrate, having quite a compressed carina, but resembles it in having few tubercles. The two oldest specimens are slightly impressed before the umbonial slope and are subangular behind.

I dedicate it to Mr. L. C. Keiner, the author of "Spécies Général et Icon. Coquil. Vivantes."

Unio Ingallsianus. Pl. XXIV. Fig. 41.

Testâ lævi, transversâ, inflatâ, cylindraccâ, posticè acuto-angulatâ, e natibus posticè bilineatis; valvulis subtenuibus; natibus subprominentibus; epidermide tenebroso-olivaccâ, striatâ; dentibus cardinalibus præ-longis, laminatis et in valvula dextrâ solum duplicibus; lateralibus longis, laminatis, rectis; margaritâ cæruleo-albâ et valdè iridescente.

Shell smooth, transverse, inflated, cylindrical, acutely angular behind, with two lines posteriorly from the beaks; valves rather thin; beaks rather prominent; epidermis dark-olive, striate; cardinal teeth very long, lamelliform, straight and in the right valve only double; lateral teeth long, lamelliform, straight; nacre bluish-white and very iridescent.

Hab. Siam, Thomas R. Ingalls, M. D.
My cabinet and cabinet of Dr. Ingalls.

Diam. .7, Length .8, Breadth 1.9 inches.

Shell smooth, very transverse, inflated, cylindrical, acutely angular behind, obtusely rounded before, with two minute, slightly elevated lines running from the beaks towards the posterior margin, on the posterior slope flattened, near the basal margin slightly compressed; substance of the shell rather thin; beaks rather prominent, submedial; ligament short and rather thick; epidermis dark-olive, dull, striate over the whole disk, without rays; umbonial slope obtusely angular; cardinal teeth very long, lamelliform, straight, and in the *right valve* only, double; lateral teeth long, lamelliform, straight and double in the left valve; anterior cicatrices confluent; posterior cicatrices confluent; dorsal cicatrices placed on the plate immediately over the centre of the cavity of the beaks; cavity of the shell deep and rounded; cavity of the beaks rather shallow and rounded; nacre bluish-white, pearly and iridescent.

Remarks.—This very interesting shell was sent to me by Dr. Ingalls, of Greenwich, N.Y. It was the only new one among several he received from Siam. To his kindness for this and other species, I am indebted, and I dedicate it to him. The form is very unusual, and assimilates to the *U. Caillaudii*, Fer., from Egypt. The colour is of the same dull olive. It may be distinguished in the exterior by its being less cylindrical and more angular behind; and in the interior, by the peculiar form of the cardinal teeth, which are long and lamelliform and double in the *right* valve, while in the *Caillaudii* they are short, erect, and double in the left valve. The beaks are also much more medial. The nacre is of an uncommonly fine pearly character, and in this specimen it is delicately striate from the cavity of the beaks towards the margin. In the description, it may be observed that I have stated the anterior cicatrices to be confluent, a rather unusual character in the *Uniones*. Of the smaller under cicatrix there is no appearance in this specimen, but it may be embraced in the large one. There is, however, a very distinct cicatrix *above* the large one. It is much to be regretted that the soft parts were not preserved, as the peculiar cardinal teeth and muscular cicatrices indicate a different disposition of the muscular fibres of the adductor and retractor muscles. The enlargement on the posterior portion of the disk towards the basal margin, indicates the female character of this specimen.

Unio nigellus. Pl. XXIV. Fig. 42.

Testâ lævi, ellipticâ, antice compressâ, valdè inæquilaterali, posticè obtuso-biangulatâ; valvulis tenuibus; natibus prominulis: epidermide nitidâ, nigrâ; dentibus cardinalibus parvis, acuminatis, crenulatis; lateralibus prælongis curvisque; margaritâ cæruleo-albâ et valdè iridescente.

Shell smooth, elliptical, compressed before, very inequilateral, obtusely biangular behind; valves thin; beaks a little prominent; epidermis shining, black; cardinal teeth small, pointed, crenulate; lateral teeth long and curved; nacre bluish-white and very iridescent.

Hab. Chatahoochee river, near Columbia, Georgia, Dr. Boykin.

My cabinet.

Diam. .5, Length .9, Breadth 1.6 inches.

Shell smooth, elliptical, compressed before, very inequilateral, obtusely biangular behind; substance of the shell thin, thicker before; beaks a little prominent and placed near to the anterior margin; ligament rather long and thin; epidermis shining, black, with distant marks of growth; posterior slope rather compressed, and with an indented line from the beaks to the margin; umbonial slope inflated and rounded; cardinal teeth small, pointed, crenulate; lateral teeth long, curved and removed from the cardinal teeth; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed above the centre of the cavity of the beaks; palleal cicatrix impressed; cavity of the shell rather deep; cavity of the beaks shallow and subangular; nacre white and beautifully iridescent.

Remarks.—A single specimen of this species was received by me some years ago, from my late friend, Dr. Boykin, to whose kindness I owe many interesting and new species from the fruitful locality of Columbia. Having never been able to obtain other specimens, I have delayed until now its description. Older or younger specimens may present different characters. This specimen is in good condition, but the beaks are not perfect, and in younger and perfect specimens, the epidermis may not be so dark as this. It is allied to *U. occultus*, (Nobis,) but is not so compressed nor so high in the carina. The *occultus* is also much more rayed.

Unio nux. Pl. XXIV. Fig. 43.

Testâ lævi, ellipticâ, convexâ, subinæquilaterali, posticè subangulatâ; valvulis percrassis; natibus prominentibus, rotundatis; epidermide tenebroso-fuscâ, radiatâ; dentibus cardinalibus subgrandibus; lateralibus brevis rectisque; margaritâ argenteâ et iridescente.

Shell smooth, elliptical, convex, somewhat inequilateral, subangular behind; valves very thick; beaks prominent, rounded; epidermis dark-brown, radiated; cardinal teeth rather large; lateral teeth short and straight; nacre very white and iridescent.

Hab. Alabama river, Mr. Wheatley.

My cabinet and cabinets of Dr. Budd and Mr. C. M. Wheatley, New York.

Diam. .6, Length .8, Breadth, 1.1 inches.

Shell smooth, elliptical, convex, somewhat inequilateral, rounded before, subangular behind; substance of the shell very thick, much thinner behind; beaks prominent, inflated towards the umbo; ligament very short and rather thick; epidermis dark-brown, obscurely radiated, yellow on the posterior slope, with a single curved ray from the beak to the

margin, marks of growth rather distant and distinct; umbonial slope obtusely angular; cardinal teeth rather large, double in the right and single in the left valve, crenulate, pointed; lateral teeth short and straight; anterior cicatrices distinct; posterior cicatrices distinct; dorsal cicatrices small and placed on the under side of the plate between the cardinal and lateral teeth; cavity of the shell deep and rounded; cavity of the beaks rather deep and angular; nacre very white and very iridescent on the posterior portion of the valve.

Remarks.—There are three specimens before me of this small species. The largest is scarcely an inch wide, but may not be entirely mature. It looks somewhat like *U. decisus*, (Nobis,) but may be distinguished by its colour and by the place and form of the beak. It is not an oblique species, but in outline more like *U. glans*, (Nobis.) In the yellow colour of the posterior slope it resembles *U. ebenus*, (Nobis,) but it is not so rotund as that shell, and has the beaks more medial. The posterior portion of the valve is remarkably thin for so thick a species, and the nacre uncommonly pearly and iridescent.

Unio nigrinus. Pl. XXIV. Fig. 44.

Testâ lævi, obovatâ, subinflatâ, inæquilaterali, nigrâ; valvulis tenuibus; natibus subprominentibus; dentibus cardinalibus parvis, acuminatis; lateralibus longis curvisque; margaritâ subpurpureâ et iridescente.

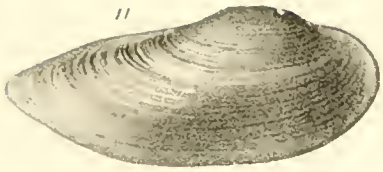
Shell smooth, obovate, somewhat inflated, inequilateral, black; valves thin; beaks slightly prominent; cardinal teeth small, pointed; lateral teeth long and curved; nacre somewhat purple and iridescent.

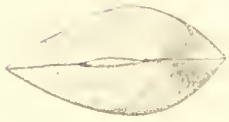
Hab. West Florida, Major Le Conte.
Cabinet of Major Le Conte.

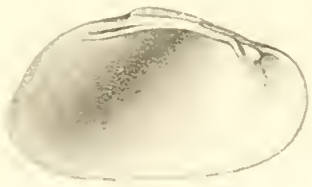
Diam. .7, Length 1.1, Breadth 1.9 inches.

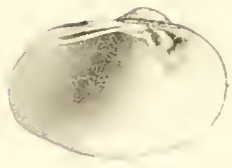
Shell smooth, reversely ovate, somewhat inflated, inequilateral, rounded before and behind, black; substance of the shell thin; beaks slightly prominent and approaching the anterior margin; ligament short and very thin; epidermis smooth, somewhat shining, black, with very indistinct rays and approximate lines of growth; cardinal teeth small, double in both valves, pointed and more acuminate on the anterior division; lateral teeth long, thin and curved; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed in the centre of the cavity of the beaks; cavity of the shell rather deep and rounded; cavity of the beaks shallow and slightly angular; nacre somewhat purple and very iridescent posteriorly.

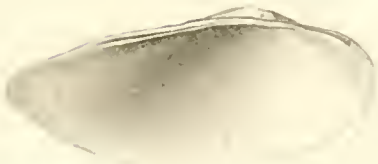
Remarks.—A single specimen of this species, not very perfect, and eroded at the beaks, was among the West Florida shells from Major Le Conte. In outline, it approaches *U. amygdalum*, (Nobis,) but differs in being a larger shell, thinner, black on the outside and purple within. It is not so purple as the *U. cuprinus*, (Nobis,) nor is it so light in the epidermis. It is also nearly allied to *U. occultus*, (Nobis,) but is not so wide a species and is rounder on the umbonial slope.

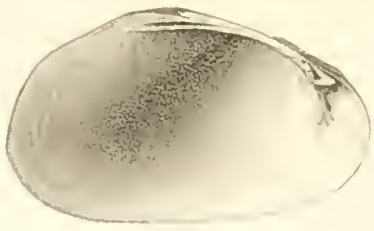












11 Unio Ingallsianus
12 " ingellus
13 " nux
11 " nigrinus

Sinclair Lith

Anodonta denigrata. Pl. XXV. Fig. 45.

Testâ lævi, elliptică, convexiusculâ, inæquilaterali, anticè rotundatâ; valvulis tenuibus: natibus prominulis, ad apices undulatis; epidermide politâ, brunco-nigricente, obsoletè radiatâ; margaritâ cæruleâ albâ et iridescente.

Shell smooth, elliptical, somewhat inflated, inequilateral, rounded before; valves thin, beaks slightly prominent, undulated at the tip; epidermis polished, blackish-brown, obscurely rayed; nacre bluish-white and iridescent.

Hab. Campbell county, East Tennessee, President Estabrook.
My cabinet and cabinet of President Estabrook.

Diam. .8, Length 1.2, Breadth 2.2 inches.

Shell smooth, elliptical, somewhat inflated, inequilateral, rounded before and very slightly flattened on the anterior part, with a slightly curved dorsal line a little irregular near the point of the beak; substance of the shell thin, very slightly thicker and whiter before; beaks very small and very slightly prominent, rather concentrically undulate at the tip; ligament thin and rather long; epidermis polished, blackish-brown, sometimes dark-greenish-brown, and obtusely rayed, with distant marks of growth. Posterior slope rather wide, and not much compressed; with three rather obscure dark-green rays, from the beak to the posterior margin; umbonial slope rounded and but slightly raised; anterior cicatrices confluent; posterior cicatrices confluent; dorsal cicatrices immediately above the centre of the cavity of the beaks; cavity of the shell not very deep, oval; cavity of the beaks very shallow and rounded; nacre bluish-white and iridescent.

Remarks.—This is rather a small species, of which President Estabrook sent me some dozen specimens. It is a distinct species, and more nearly allied to *An. Ferussaciana*, (Nobis,) than to any other species. It differs in being a smaller species, in being more compressed, and in having a much less callus on the dorsal margin. Indeed, in some of the specimens no callus can be perceived. The undulations of the beaks are simple and nearly concentric, like the *Ferussaciana*, but they are smaller. In all the specimens but a half-grown one, there is a rough, opake, white, carious mark of disease about the anterior cicatrix and the cavity of the beaks. The younger one is without this mark of disease. This specimen is greenish, and has the lines of growth very distinctly marked.

Anodonta opaca. Pl. XXV. Fig. 46.

Testâ lævi, elliptică, subinflatâ, inæquilaterali, posticè angulatâ: valvulis tenuibus: natibus subprominentibus, ad apices undalatis; epidermide opacâ, nigricente, obsolete radiatâ; margaritâ albâ et iridescente.

Shell smooth, elliptical, rather inflated, inequilateral, angular behind; valves thin, beaks rather prominent, undulate at the tip; epidermis dark, almost black, obscurely rayed; nacre white and iridescent.

Hab. Near New Orleans, Mons. Janin. Little Rock, Arkansas, Prof. Powell.
My cabinet and cabinets of Prof. Powell and Dr. Hale.

Diam. 1.5, Length 2.1, Breadth 3.4 inches.

Shell smooth, elliptical, rather inflated, inequilateral, angular behind, slightly curved on the dorsal line; substance of the shell thin; beaks rather prominent and undulated at the tip; ligament rather short and somewhat thick; epidermis dark, almost black, coarsely

striate, obscurely rayed, with distant lines of growth; posterior slope wide, very dark, and with obscure rays; umbonial slope very obscurely angular; anterior cicatrices confluent; posterior cicatrices confluent; dorsal cicatrices placed anterior to the cavity of the beaks; palleal cicatrix scarcely perceptible; cavity of the shell rather deep and oval; cavity of the beaks rather shallow and rounded; nacre white and iridescent.

Remarks.—I have had several specimens of this species many years, and have had great difficulty where to place it. It is nearest allied to *An. fluviatilis*,—a species which has a most remarkably extended geographical range; but it seems to me to differ too much to retain it in that species. It differs in being less transverse, in the beaks being more medial, and in the epidermis being darker. It is also a little more enlarged on the umbonial slope. Being always very desirous to keep the number of our species as limited as possible, I very often defer for years describing specimens as new, which I cannot place satisfactorily with those already characterized. More recently, I have received from Prof. Powell several specimens of the same characteristics, from Little Rock, and I think it will be found by the naturalists of Louisiana and Arkansas, whence it comes, that the characters will be found constantly to differ enough to distinguish it from *fluviatilis*, which flourishes more than any other Anodonta in the middle states.

Anodonta Californiensis. Pl. XXV. Fig. 47.

Testâ subalatâ, lævi, ellipticâ, subinflatâ, posticè rotundatâ; valvulis tenuibus; natibus minutis, ad apices undulatis; epidermide virido-olivaceâ, nitidâ; margaritâ albâ et iridescente.

Shell subalate, smooth, elliptical, somewhat inflated, rounded behind; valves thin, beaks very small and undulated at the tips; epidermis olive-coloured, shining; nacre white and iridescent.

Hab. Rio Colorado, California, J. L. Le Conte, M. D.
My cabinet and cabinet of Major Le Conte.

Diam. .8, Length 1.3, Breadth 2.2 inches.

Shell subalate, smooth, elliptical, somewhat inflated, rounded behind, slightly compressed towards the anterior basal margin; substance of the shell thin and fragile, beaks very small, scarcely rising above the dorsal line, finely undulate at the tip; ligament rather short and thin; epidermis virido-olivacea, shining, with rather distant marks of growth; posterior slope rather broad, compressed and raised nearly into a wing, with three distinct green rays from the beak to the margin; umbonial slope inflated and rounded; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices nearly in the centre of the beaks; palleal cicatrix scarcely visible; cavity of the shell rather deep; cavity of the beaks exceedingly shallow; nacre white.

Remarks.—Dr. Le Conte procured but two or three specimens of this, which was the only species of the family Naïades he saw in California. This marks a very singular difference in the existence of these forms of animal life, from those in the waters of the more eastern states, where they exist in such profusion, and in such a great number of various forms and habits. This species is more nearly allied, indeed it is closely allied to *An. Nuttalliana*, which I described many years since, and which was brought by Mr. Nuttall from

15 Anodonta decorata
16 " opaca
17 " Californiensis

Wahlamat river, in Oregon. It differs in being a smaller species, in being more inflated, and particularly so in the superior part. In this shell the umbonial slope is smaller from the beaks to the posterior dorsal margin. In the *Nuttalliana* the upper portion of the umbonial slope is flattened, but it enlarges towards the posterior basal margin, and there makes the greater diameter. In the *Californiensis* the greatest diameter is about the middle of the disk, and there is a marked difference in the wing, which is by no means so much elevated.

Anodonta Trautwiniana. Pl. XXVI. Fig. 48.

Testâ lævi, oblongâ, subinflatâ, inæquilaterali, e natibus lineatis; valvulis crassis; natibus prominulis, ad apices minutè undulatâ; epidermide virido-olivaceâ, rugoso-striatâ; margaritâ argenteâ et iridescente.

Shell smooth, oblong, somewhat inflated, inequilateral, with a line from the beaks; valves thick; beaks somewhat prominent, at the tips minutely undulated; epidermis greenish-olive and roughly striate; nacre silvery and iridescent.

Hab. Carthagena, South America, John C. Trautwine, Esq.

My cabinet and cabinet of the Academy of Natural Science.

Diam. .9, Length 1.5, Breadth 2.5 inches.

Shell smooth, oblong, somewhat inflated, inequilateral, obtusely rounded before, subalate behind, with a line from the beaks to the posterior margin; substance of the shell thick; beaks somewhat prominent, submedial, at the beaks very minutely undulated; ligament very long and thin, not protruding above the dorsal line of the valves; epidermis greenish-olive, and roughly striate, quite imbricate behind, without rays; umbonial slope elevated into a carina; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices none; palleal cicatrix slightly impressed; cavity of the shell rather deep and rounded; cavity of the beak very shallow and subangular; nacre silvery white, with minute striæ from the beaks towards the margin; iridescent.

Remarks.—The friends of Mr. Trautwine owe to him the possession of this interesting species, of which he brought many specimens, and liberally distributed them. It differs from any South American species which has come under my notice. It is a much smaller species than *An. trapezialis*, Lam., rougher in the epidermis and more oblong. Some of the specimens are somewhat greenish, others yellowish-olive. The triangular fosset at the end of the ligament, so usual in the South American *Naïades*, is very perceptible in this species.

In outline, it is allied to *tetragona*, (Nobis.)

Anodonta Wheatleyi. Pl. XXVI. Fig. 49.

Testâ lævi, transversâ, subinflatâ, gibbosâ, valdè inæquilaterali, posticè angulatâ, antice irregulariter rotundatâ; valvulis crassis; natibus tumidis, parum elevatis, ferè terminalibus; epidermide cinnamomea, radiata; margaritâ salmonis colore tinctâ et valdè iridescente.

Shell smooth, transverse, rather inflated, gibbous, very inequilateral, angular behind, irregularly rounded before; valves thick; beaks swollen, a little elevated and almost terminal; epidermis cinnamon-red and rayless; nacre salmon-coloured and very iridescent.

Hab. Para, South America, Mr. C. M. Wheatley.
My cabinet and cabinet of Mr. Wheatley.

Diam. .8, Length 1.1, Breadth 2.2 inches.

Shell smooth, transverse, rather inflated, gibbous, very inequilateral, angular behind, irregularly rounded before, slightly compressed near to the anterior margin and straight on the dorsal line; substance of the shell thick; beaks swollen, a little elevated and placed near to the anterior margin; ligament very long and very thin, scarcely protruding above the dorsal line; epidermis cinnamon-red, reddish-brown along the margin, totally without rays, the lines of growth approximate; posterior slope very long, rather wide, somewhat compressed, with a thin, coloured, elevated hair-like line passing from the beaks to the posterior margin; umbonial slope elevated and rounded; anterior cicatrices distinct, the smaller one very minute; posterior cicatrices confluent; no visible dorsal cicatrices; palleal cicatrices slightly impressed; cavity of shell rather shallow; cavity of the beaks rather shallow and subangular; nacre with minute striæ from the beaks towards the margin, of a beautiful light salmon colour, and magnificently iridescent.

Remarks.—Of this beautiful South American *Anodonta*, I have but a single specimen before me. It differs from any of the species described by Spix or D'Orbigny, and is altogether a very remarkable species. It is a stout shell, with a nacre which is softer, richer and more satin-like than in any I have ever seen. The nacre is a light salmon colour, with a tint of purple, which gives the most surprising softness and brilliancy to it. The margin is dark, but the nacre immediately in contact with it gives a line of fine blue and green. The triangular fosset at the end of the ligament, common to the South American species, is very marked in this.

I owe this and many other fine shells of this family to my friend Mr. Wheatley, and I dedicate this beautiful one to him.

Anodonta Shaefferiana. Pl. XXVI. Fig. 50.

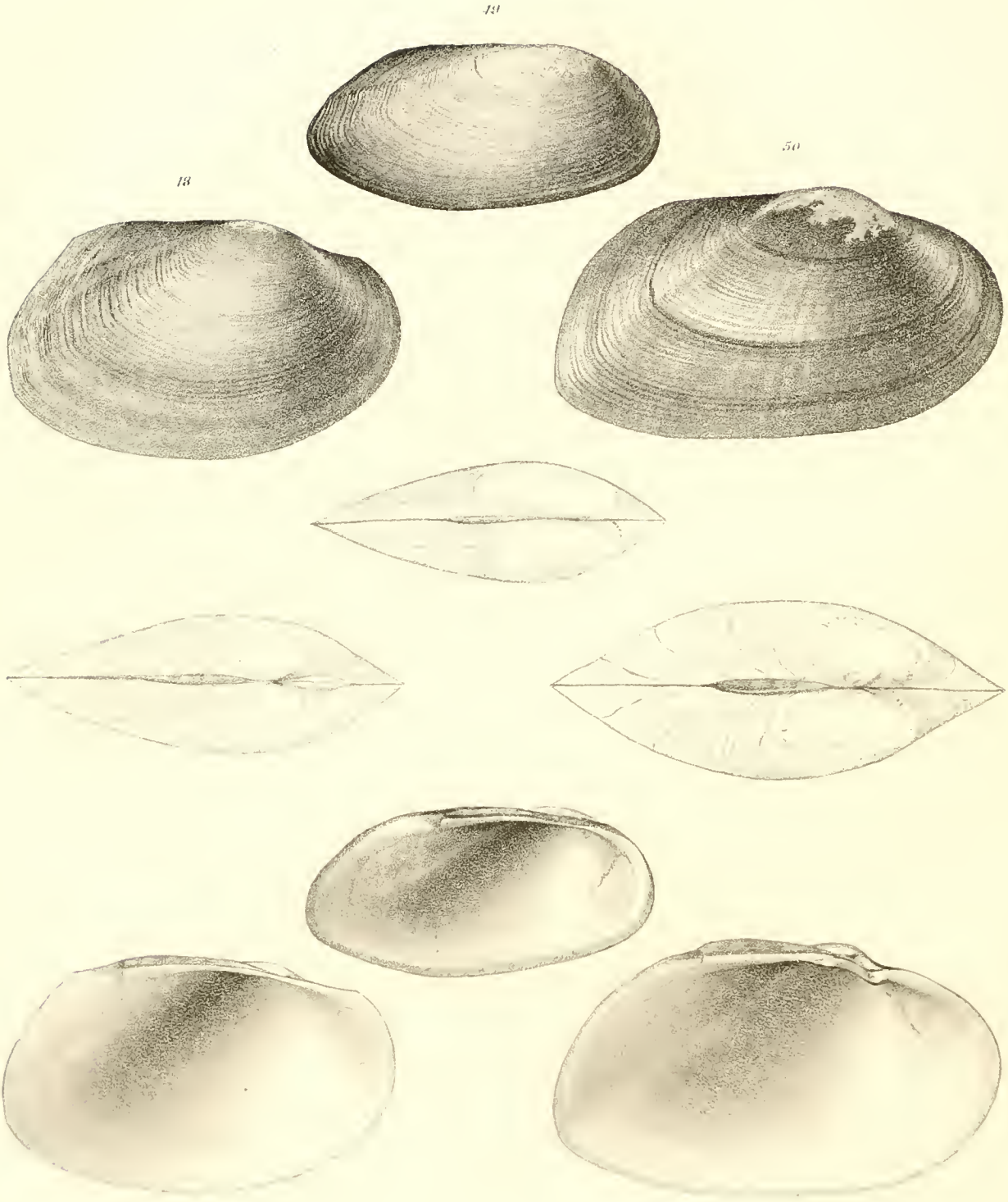
Testâ lævi, oblongâ, inflatâ, inæquilaterali, posticè angulatâ; valvulis subcrassis; natibus prominentibus, ad apices undulatis; epidermide castaneâ, nitidâ, obsoletè radiatâ; margaritâ salmonis colore tinctâ.

Shell smooth, oblong, inflated, inequilateral, angular behind; valves rather thick; beaks somewhat prominent, undulated at the beaks; epidermis shining, chestnut-coloured and obsoletely rayed; nacre salmon coloured.

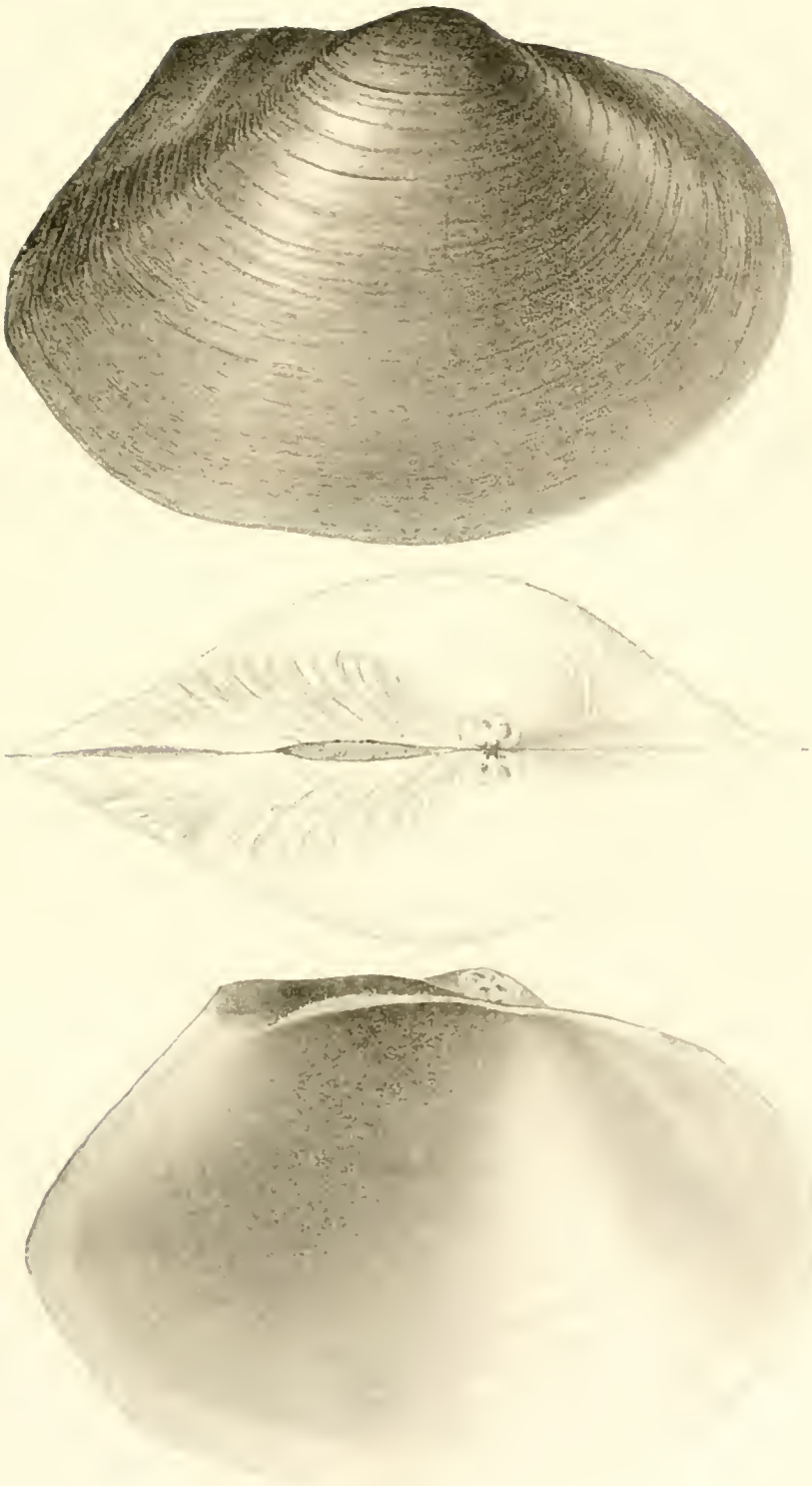
Hab. Horn Lake Creek, Tenn., Mr. Shaeffer.
My cabinet and cabinet of Mr. Shaeffer.

Diam. 1.2, Length 1.7, Breadth 2.8 inches.

Shell smooth, oblong, inflated, inequilateral, angular behind, rounded before; dorsal line under the beak, interrupted by a double, tuberculous callus; substance of the shell thick; beaks somewhat prominent, submedial, coarsely undulated at the tip; ligament rather short and thick; epidermis shining, chestnut coloured, obsoletely rayed, with distinct distant marks of growth; posterior slope broad and somewhat flattened; umbonial slope angular from beak to margin; anterior cicatrices confluent; posterior cicatrices confluent; dorsal cicatrices placed above the cavity of the beaks and partly on the tuberculate swellings; palleal cicatrix slightly impressed; cavity of the shell deep and broad; cavity of the beaks deep and subangular; nacre salmon-coloured and brilliant.



18 *Anodonta Troutwiniana*.
19 " *Wheatleyi*.
50 " *Shattériana*



Remarks.—This species is nearly allied to *A. tetragona*, (Nobis,) but seems to me too distinct to be considered the same. The outline is much the same, but the tuberculous swellings under the beak are more enlarged than in that species. The umbonial angle is also more sharp. There are two specimens before me, both of which have beautiful salmon-coloured nacre. A third specimen, also from Mr. Shaeffer, marked "Missouri," is somewhat like the others, but approaches more to some of the varieties of *arcolatus*, Swain.*

I owe this and several other fine shells to Mr. Shaeffer, an ardent collector of Cincinnati, and I name this one after him.

Anodonta Linnæna. Pl. XXVII. Fig. 51.

Testâ lævi, rotundatâ, valdè inflatâ, subæquilaterali, posticè obtusè angulatâ; valvulis subtenuibus; natibus prominentibus, ad apices rugoso-undulatis; epidermide luteo-viridi, nitidâ, striatâ, obsolete radiata: margaritâ salmonis colore tinctâ et iridescente.

Shell smooth, rotund, very much inflated, nearly equilateral, obtusely angular behind; valves rather thin; beaks prominent and rugosely undulate at the tip; epidermis yellowish-green, shining, striate, obscurely rayed; nacre salmon-coloured and iridescent.

Hab. Lake Concordia, Louisiana, Mr. C. M. Wheatley.

My cabinet and cabinet of Mr. Wheatley.

Diam. 1.9, Length 2.8, Breadth 4.1 inches.

Shell smooth, rotund, much inflated, nearly equilateral, obtusely angular behind; very much inflated and rounded at the umbones, curved on the dorsal line; substance of the shell rather thin; beaks prominent, inflated, and rugosely wrinkled at the tip; ligament rather short and somewhat thick; epidermis yellowish-green, shining, rather roughly striate, obscurely rayed and very dark on the posterior slope; posterior slope broad, short, rather flattened, and very rugose; umbonial slope angular; anterior cicatrices confluent; posterior cicatrices confluent; dorsal cicatrices placed near to the edge, some distance anterior to the point of the beaks; palleal cicatrix scarcely visible; cavity of the shell very deep and rounded; cavity of the beaks deep and rounded; nacre beautifully salmon-coloured, rich, and iridescent, leaving a very broad border round the margin.

Remarks.—This is the finest species of *Anodonta* I have seen from our country. It is most beautifully coloured in the nacre, which is exceedingly brilliant. A single specimen only is before me, and this is somewhat fractured. The margin is very uncommonly broad, without any pearly nacre, and white. The epidermis is rough with striæ, and yet it looks rich and pleasing. The green rays are broad and iridescent. This species is allied to *An. globosa*, (Nobis,) from Mexico; but it differs much in the smoothness and polish which the latter shell has. The beaks are more medial and the margin

* When in Cincinnati, nearly two years since, Mr. J. Clarke gave me a suite of a species of *Anodonta* which he considers to be the true *edentula* of Mr. Say, described in "The Disseminator." They were taken from the river Ohio, near that city, and are not found in Mill Creek, near by, where the *arcolatus* abounds. He says that they differ in the beaks, and in the outline they appear to me to differ very much,—the Ohio shell being very wide and oblong, while the Mill Creek shell is oval, and usually larger. The latter is also more rayed.

much broader. In colour they are entirely different. One is white, the other salmon-coloured. The fosset at the end of the ligament is remarkably large and curved.

This beautiful species I dedicate to the memory of the great master in natural science, *Linnæus*.

Anodonta oblita. Pl. XXVIII. Fig. 52.

Testâ lævi, ellipticâ, compressâ, inæquilaterali, posticè subbiangulatâ; valvulis pertenuibus; natibus prominulis, ad apices undulatis; epidermide nitidâ, bruneo-viridi, obsoletè radiatâ; margaritâ cæruleâ albâ et iridescente.

Shell smooth, elliptical, compressed, inequilateral, subbiangular behind; valves very thin; beaks slightly prominent, undulated at the tip; epidermis shining, brownish-green, obscurely radiated; nacre bluish-white and iridescent.

Hab. Campbell county, East Tennessee, President Estabrook.

My cabinet and cabinet of President Estabrook.

Diam. .7, Length 1.2, Breadth 2 inches.

Shell smooth, elliptical, compressed, inequilateral, subbiangular behind, rounded before and slightly flattened on the anterior portion of the disk, with a simple curved dorsal line; substance of the shell very thin; beaks very small, slightly prominent and undulate at the tip; ligament rather thin and not very long; epidermis shining, brownish-green, obscurely rayed, with rather distant marks of growth; posterior slope rather narrow and somewhat compressed, with three distinct and somewhat distant green rays from the beaks to the posterior margin; umbonial slope rounded and considerably raised; anterior cicatrices confluent; posterior cicatrices confluent; dorsal cicatrices on the inside of the dorsal line; cavity of the shell very shallow; cavity of the beaks very shallow; nacre bluish-white and iridescent.

Remarks.—I received but three specimens from President Estabrook of this species. The largest, although small, seems to be adult. The green colour of the posterior portion of the valve is dark and fine. There are here three rather broad and unusually distinct rays, the inferior one being the largest, and well over the umbonial slope. The anterior portion of the disk is darker and brownish. This species is perhaps the nearest allied to *An. denigrata*, herein described. It may be distinguished by its being more compressed, greener and smaller.

Anodonta virens. Pl. XXVIII. Fig. 53.

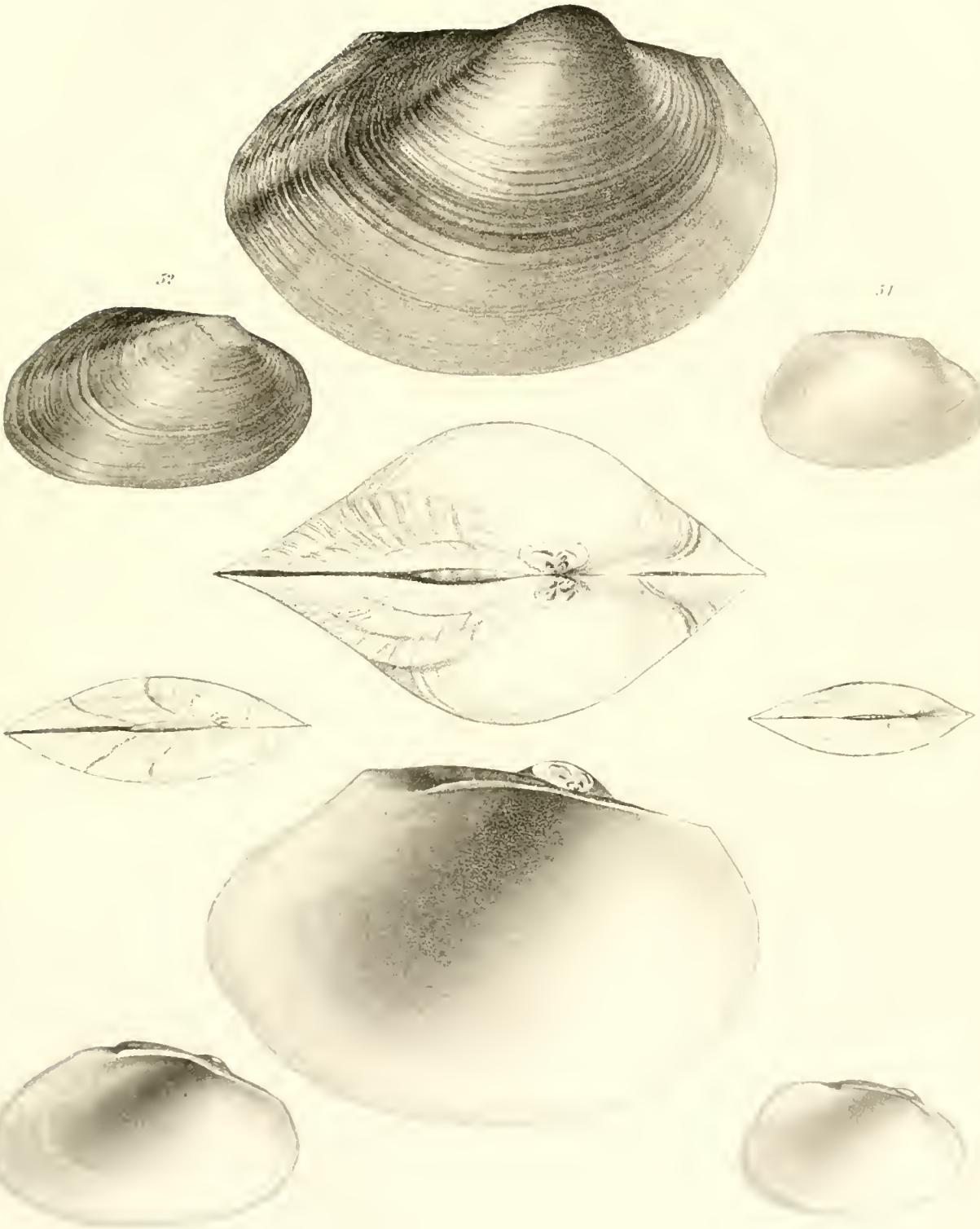
Testâ lævi, ellipticâ, ventricossissimâ, inæquilaterali, posticè subangulatâ; valvulis tenuibus; natibus prominentibus, valdè tumidis, ad apices rugoso-undulatis; epidermide viridi, politâ, obsoletè radiatâ; margaritâ albâ et iridescente.

Shell smooth, elliptical, very much inflated, inequilateral, subangular behind; valves thin; beaks prominent, very much swollen and rugosely undulate at the tip; epidermis green, polished, obscurely radiated; nacre white and iridescent.

Hab. Red river, at Alexandria, Louisiana, J. Hale, M. D.

My cabinet and cabinet of Dr. Hale.

Diam. 1.9, Length 2.3, Breadth 3.5 inches.



52 *Anodonta oblita*
53 " *virens*
51 " *tortilis*

Shell smooth, elliptical, very much inflated, inequilateral, subangular behind, angular at the anterior dorsal margin, very much inflated and somewhat gibbous on the umbones, nearly straight on the dorsal line; substance of the shell thin; beaks prominent, very much swollen and rugosely wrinkled at the tip; ligament rather short and somewhat thick; epidermis green, polished, slightly striate, obscurely rayed, with three rather obscure rays on the posterior slope, and with distant marks of growth; posterior slope very wide, rather short, and rather depressed; umbonial slope rounded, with an irregular, slightly raised line from the beaks to the posterior margin; anterior cicatrices confluent; posterior cicatrices confluent; dorsal cicatrices invisible; palleal cicatrix not observable; cavity of the shell very deep and rounded; cavity of the beaks deep and rounded; nacre white and iridescent.

Remarks.—Several specimens are before me, of different ages. It is perhaps most nearly allied to *An. Stewartiana*, (Nobis,) but is more rotund, more inflated and smoother on the epidermis. In some of its characteristics, it approaches the *An. Linnæana*, (Nobis,) described in this paper. It differs from that in being less rotund, in having a smoother and more polished epidermis, and it differs entirely in the nacre, which is not salmon-coloured, nor so thick or brilliant.

Anodonta tortilis. Pl. XXVIII. Fig. 54.

Testâ plicatâ, obovatâ, subcompressâ, inæquilaterali, è natibus minutè lineatis; valvulis subtenuibus; natibus prominulis; epidermide olivaceâ, minutè tortile; margaritâ cæruleo-albâ et iridescente.

Shell plicate, obovate, somewhat compressed, inequilateral, minutely lined from the beaks; beaks a little prominent; valves rather thin; epidermis olive, minutely wreathed; nacre bluish-white and iridescent.

Hab. Carthagena, South America, J. C. Trautwine, Esq.

My cabinet.

Diam. .5, Length .9, Breadth 1.4 inches.

Shell plicate, obovate, somewhat compressed, inequilateral, rather obtusely rounded before and subalate behind, with a minute line from the beaks to the posterior margin; substance of the shell rather thin; beaks a little prominent, submedial; ligament rather long and thin; epidermis olive, minutely wreathed nearly over the whole disk, without rays; umbonial slope compressed and elevated into a carina; anterior cicatrices confluent; posterior cicatrices confluent; dorsal cicatrices none; cavity of the shell rather shallow; cavity of the beaks very shallow and subangular; nacre bluish-white, iridescent, with minute striæ from the beaks to the margin.

Remarks.—It is to be regretted that only a single specimen of this shell should have been found by Mr. Trautwine, to whose kindness I owe the possession of it. It is remarkable for the minute wreaths of the epidermis, which are distributed in festoons over most of the disk. In these wreaths it resembles the *An. crispata*, Lam., which is the only species of the family I have seen with this singular character. The specimen before me has the beaks beautifully tinged with a greenish hue, being epidermal matter deposited between the layers of nacreous matter. In the cavity of the beaks this shows quite conspicuously, and is stronger in two divergent lines. Under the lens, in this specimen, a

number of minute impressions may be observed in both valves, posterior to the anterior cicatrix. Whether these are muscular attachments or not I am not certain; older and thicker specimens would enable one to judge. It has the triangular fosset common to the South American species. The margin is broad for the size of the shell, and the granules of it are very perceptible with a microscope of good power.

This species comes so near in its characters to the *An. crispata*, my specimen of which came from Cayenne, that it is with some hesitation that I have separated it. The *tortilis* has the festooned crimples much finer, and they do not extend over the whole disk, as in the *crispata*, nor are they by any means so much impressed, but change into striæ on the posterior slope and on the anterior portion of the disk. The *tortilis* is also rather longer and more compressed towards the beaks. On the *crispata* the festooned crimples are much coarser, and the marks of growth are different. Dr. Gould, in the Proceedings of the Boston Society of Natural History, November, 1850, described an *Anodonta*, under the name of *glauca*, brought by the Exploring Expedition, which I believed at the time to be the *crispata*, Lam. The specimen seemed to me to be of the same species with that which I procured from Ferussac, in Paris, under the name of *crispata*. The name of *glauca* also is preoccupied by Valenciennes, for another *Anodonta* from South America. It is with some hesitation I place this in the division of "plicate" species, as it almost requires a lens to see the folds, but it cannot be called a "smooth" shell.

Anodonta Schröteriana. Pl. XXIX. Fig. 55.

Testâ lævi, transversâ, subcompressâ, valdè inæquilaterali, posticè obtuso-biangulari; valvulis subcrassis; natibus prominentibus, acutis; epidermide rugosâ, crebrissimè striatâ, tenebroso-olivâ, obsolete radiâtâ; margaritâ albâ et iridescente.

Shell smooth, transverse, rather compressed, very inequilateral, obtusely angular behind; valves rather thick; beaks prominent and pointed; epidermis rough, thickly striated, dark-olive, indistinctly radiated; nacre white and iridescent.

Hab. Rio Negro, Brazil, Mr. C. M. Wheatley.

My cabinet and cabinet of Mr. Wheatley.

Diam. .9, Length 1.5, Breadth, 3.1 inches.

Shell smooth, transverse, rather compressed, very inequilateral, obtusely biangular behind, slightly compressed on the sides near the middle of the dorsal line, with a slight callus under the beaks; substance of the shell rather thick; beaks prominent, pointed and placed towards the anterior margin; ligament long and rather thin; epidermis very rough, covered with very close crimpled striæ, dark-olive, with a few indistinct rays over the posterior slope, and with rather distant lines of growth; posterior slope long, compressed into a carina; umbonial slope slightly raised and rounded; anterior cicatrices distinct, the smaller one very minute; posterior cicatrices confluent; no visible dorsal cicatrices; palleal cicatrices slightly impressed; cavity of the shell rather shallow and wide; cavity of the beaks shallow and angular; nacre with minute striæ from the beaks towards the margin, white and iridescent.

Remarks.—A single specimen, or rather the two valves of different individuals, was kindly given to me by Mr. Wheatley. It does not seem to have been noticed by Spix or

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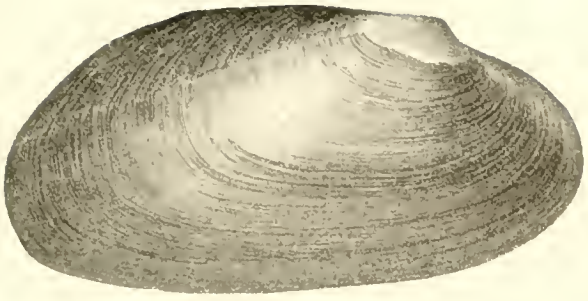

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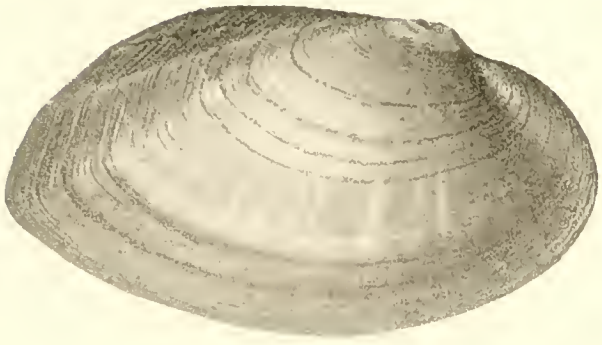
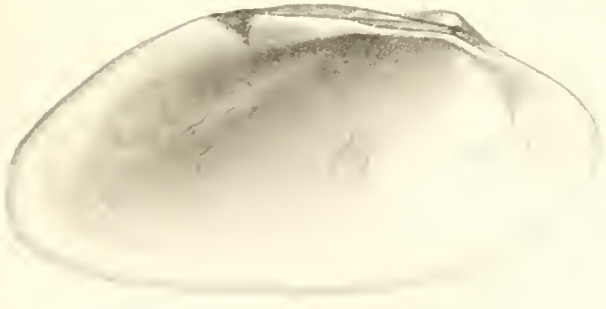
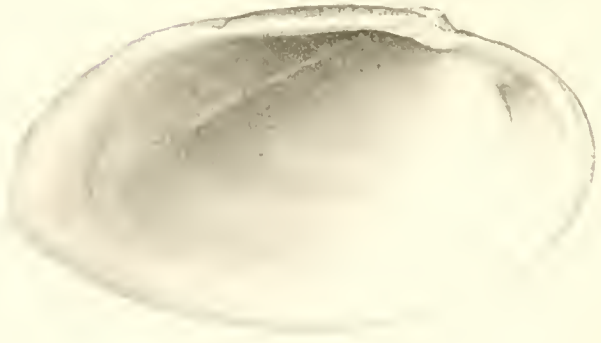






55 *Anodonta Schroteriana*
56 " *Arkansensis*

by D'Orbigny. It is very peculiar in the texture of the epidermis, which is crimpled up into irregular, somewhat parallel, very close, rugose lines, which cover the whole surface of the disk. In both of these valves there is a distinct muscular impression above the great anterior cicatrix, which I have not observed before in any of the *Anodontæ*. The absence of a dorsal cicatrix is also unusual; but in this it resembles some of the other South American species, viz.: *Anodonta ensiformis*, Spix, *soleniformis*, D'Orb, &c. In outline it is nearly allied to *An. exilis*, (Nobis,) but it has not the straight dorsal line, is a thicker shell, and has a very different epidermis. The triangular fosset at the end of the ligament is rather large and well marked. The right valve has a few black pencilled marks in the nacre, such as are sometimes seen in the South American *Anodontæ*. These are remarkable as being nearly parallel, and in a direction pointing to the beaks. They look as if made by a pen, with black ink.

I name this fine species in honour of the memory of Schröster, author of Flusconchlien, &c.

Anodonta Arkansensis. Pl. XXIX. Fig. 56.

Testâ lævi, elliptică, compressâ, valdè inæquilaterali, posticè subbiangulatâ; valvulis crassis; natibus subprominentibus, ad apices undulatis; epidermide subviridi, radiatâ, striatâ; margaritâ cæruleo-albâ.

Shell smooth, elliptical, compressed, very inequilateral, subbiangular behind; valves thick; beaks rather prominent and undulated at the tip; epidermis greenish, rayed; nacre bluish-white.

Hab. Little Arkansas, J. L. Le Conte, M. D.
Cabinet of Major Le Conte.

Diam. .9, Length 1.7, Breadth 3 inches.

Shell smooth, elliptical, compressed, subbiangular behind and rounded before, subangular on the posterior slope; substance of the shell thick; beaks rather prominent, pointed, with three or four large undulations at the tip; ligament long and rather thin; epidermis greenish, striate, with unequal transverse marks of growth, dark on the posterior slope, with indistinct, broad greenish rays over the disk; posterior slope with two lines from the beak to the posterior margin; dorsal margin slightly curved, and having a callus immediately under the beak almost amounting to a tooth; anterior cicatrices distinct; posterior cicatrices confluent; dorsal cicatrices placed on the lower part of the callus; cavity of the shell rather shallow; cavity of the beaks shallow and angular; nacre bluish-white, leaving a broad dark margin.

Remarks.—A single specimen of this interesting species has been submitted to me by Dr. J. L. Le Conte, who obtained it on a late scientific excursion to the Rocky Mountains, from the Little Arkansas, where the road to Santa Fé crosses it. This species is not likely to be confounded with any other known to me, and belongs to that group which has an irregular thickening or callus under the beak on the dorsal margin, which, while it does not amount to a tooth, makes a very distinct natural group. This callus is not so large and marked as to be confounded with D'Orbigny's genus *Monocondylæa;* but it may be compared with that of *Alasmodonta edentula*, Say, which is a true *Anodonta*. The form of this species is more lenticular than in any other of the genus I know; and look-

ing on the exterior reminds us of *Symphynota compressa*, (Nobis,) changed to *U. pressus*, (Nobis.) The undulations of the beaks are large, and the epidermis of them being thin, gives the tip a whitish appearance.

SYSTEMATIC INDEX.

Unio affinus, ... Page 271
" Barrattii, ... 256
" buxeus, ... 261
" Clarkianus, ... 273
" concavus, ... 260
" Cuvierianus, ... 263
" decoratus, ... 257
" Floridensis, ... 274
" Forbesianus, ... 264
" fraternus, ... 263
" Gibbesianus, ... 254
" hebes, ... 267
" Hanleyianus, ... 279
" ineptus, ... 261
" Ingallsianus, ... 282
" Keinerianus, ... 281
" Kleinianus, ... 265
" Lamarckianus, . . . 266
" Lazarus, ... 259
" luridus, ... 273
" merus, ... 260
" Moussonianus, . . . 268
" nigellus, ... 283
" nigerrimus, ... 268
" nigrinus, ... 284
" nux, ... 283
" Oregonensis, ... 275
" perstriatus, ... 255
Unio placitus, ... Page 279
" Powellii, ... 270
" Prevostianus, . . . 269
" proximus, ... 271
" pygmæus, ... 262
" Reeveianus, ... 272
" rufusculus, ... 258
" Rumphianus, ... 276
" sagittiformis, ... 277
" satur, ... 265
" sordidus, ... 254
" Stewardsonii, ... 278
" succissus, ... 275
" Troschelianus, . . . 280
" Tuomeyi, ... 256
" Whiteianus, ... 258
Anodonta Arkansensis, ... 293
" Californiensis, . . . 286
" denigrata, ... 285
" Linnæana, ... 289
" oblita, ... 290
" opaca, ... 285
" Schröteriana, . . . 292
" Schafferiana, . . . 288
" tortilis, ... 291
" Trautwiniana, . . . 287
" virens, ... 290
" Wheatleyi, ... 287

ARTICLE XIX.

Description of a New Genus (Basistoma,) of the Family Melaniana, together with some New Species of American Melaniæ. By Isaac Lea. Read March 5th, 1852.

FAMILY MELANIANA.

GENUS BASISTOMA.*

Testa conica. Apertura ovata, basi abscissa. Labrum acutum. Columella lævi. Operculum ——.

The particular shell for which I propose this genus was given to me by Amory Edwards, Esq., late the Consul of the United States at Rio, who brought it from four hundred miles up the river Tocatinus, five hundred miles distant from the ocean, at the mouth of the Amazon. It differs from any of the family of *Melaniana* in the cut at the base, and it has none at the superior part of the aperture. It comes near to *Pirena*, but wants the superior cut, and it differs from *Melanopsis* in its general form as well as in having no callus on the columella. The *Melaniana* being so enormously developed, and having but few genera, I think it advisable to constitute new ones, whenever a group can be well characterized, which is the case with this form. I think that *Melania transversa*, (Nobis,) from Guiana, and *M. Braziliensis*, (Nobis,) would properly come under this division, and very likely other characteristic species will be found in that portion of South America whence these three come. The genus *Melatoma*, Swainson, is a well characterized group in some respects near to this. While it is emarginate at base, it has an emargination also towards the upper portion of the outer lip, and the group, as far as I know it, has a general and well characterized outline, being somewhat mitraform. I think that my *M. microstoma*, *tornatella* and *rudis* all belong to a group which would constitute a new genus, unless it could be put into one of Mr. Swainson's genera, all the types of which I have not seen.

* βασις, base, and τεμνω, to cut.

When I proposed the name of *Schizostoma* for a genus of *Melaniana* with a cut at the superior portion of the aperture, I was not aware that M. Bronn had already used that name for a fossil genus. I now propose to substitute *Schizochilus*, from σχιζω, *to cut*, and χειλος, *lip*.

I very much regret that the operculum did not accompany this specimen, suspecting, as I do, that it will be found to differ from the genus *Melania*, and be somewhat like *M. transversa*, which I propose above to bring into this group. The operculum of this latter species was described by me as having the polar point near the centre, and having five revolutions.*

Basistoma Edwardsii. Pl. XXX. Fig. 1.

Testâ striatâ, turritâ, subcrassâ, geniculatâ, tenebroso-corneâ; spirâ valdè attenuatâ; suturis valdè impressis; anfractibus planulatis; supernè impressis, lineis crebrissimis instructis; aperturâ subgrandi, ellipticâ, intus albidâ, ad basim valdè abscissâ; columellâ lævi tortâque.

Shell striate, turreted, rather thick, geniculate, dark horn-colour; spire very much drawn out; sutures very much impressed; whorls flattened, impressed above, thickly covered with revolving lines; aperture rather large, elliptical, white within, at the base abruptly cut off; columella smooth and twisted.

Hab. River Tocatinus, South America, Amory Edwards, Esq.
My cabinet.

Diam. .50, Length 1.92, of an inch.

Remarks.—This very beautiful and interesting shell is remarkable for the new form it presents in the aperture. It is thickly striate all over the whorls, and looks like a succession of coils of rope piled on each other. The two lower whorls are impressed above the middle, which gives it a geniculate character immediately below the suture. Between the striæ there are very minute sculptured points. The apex being eroded, the number of whorls are not ascertainable, but they are probably about ten. The outer lip is very sharply edged, and the central portion very much extended on a curve. The aperture is about one-fourth the length of the shell.

The form of this species reminds one of *Achatina columna* (*Lymnea columnaris*, Lamarck,) which is however, a land shell. It is drawn out like it and has flattened sides, with a cut at the base of nearly the same form. In other characters they are not at all alike, the *columna* being sinistral, covered with granules, much larger and belonging to a different genus altogether.

I dedicate this fine species to my friend Mr. Edwards, to whom I am indebted for it and many other interesting shells from the waters and banks of the Amazon.

Melania perstriata. Pl. XXX. Fig. 2.

Testâ striatâ, acuto-conoideâ, subtenui, cinnamomeo-bruneâ; spirâ elevatâ, subattenuatâ, ad apicè carinatâ et granulatâ; suturis impressis; anfractibus septenis, convexis; aperturâ parvâ, ellipticâ, ad basim angulatâ, intus rufâ; columellâ lævi.

Shell striate, acutely conical, rather thin, cinnamon-brown; spire elevated, somewhat attenuate, at the apex carinate and granulate; sutures impressed, whorls seven, convex; aperture small, elliptical, angular at the base, reddish within; columella smooth.

* Proceedings Zoological Soc., London, 1851, p. 187.

Hab. Coosa river, Alabama, Prof. Brumby. Huntsville, Tenn., Mr. J. Clark. Tennessee, Prof. Troost.

My cabinet and cabinets of Prof. Brumby and Mr. Clarke.

Diam. .28, Length .83, of an inch.

Remarks.—Among the numerous *Melaniæ* sent to me long since by my late friend Prof. Troost, were several specimens of the young of this species. I could not satisfactorily place them in any known species, and I put them temporarily with *striatula*, (Nobis,) which is strongly allied to the species which I have described above. Recently, I have received from Prof. Brumby and from Mr. J. Clark several adult specimens, which leave the younger in my possession no longer in doubt,—they were recognised at once to belong to those more recently received. All the specimens—some dozen—before me are reddish; the *striatula* is horn-coloured, with a white aperture. The latter is also flatter in the whorls, and not so carinate above, nor are the sutures so deeply impressed. Some of the specimens are quite smooth on the body whorl. Aperture about one-third the length of the shell.

Melania sculptilis. Pl. XXX. Fig. 3.

Testâ perstriatâ, conoideâ, subtenui, corneâ; spirâ acuminatâ, ad apicem carinatâ et granulatâ; suturis irregulariter impressis; anfractibus decim, subplanulatis; striis crebris et inter sculpturatâ; aperturâ parvâ, elliptieâ, ad basim angulatâ, intus albidâ; columellâ incurvâ tortâque.

Shell thickly striate, conical, rather thin, horn colour; spire pointed, towards the apex carinate and granulate; sutures irregularly impressed; whorls ten, rather flattened; striæ close, and between them sculptured; aperture small, elliptical, angular at base, white within; columella incurved and twisted.

Hab. Tennessee, Mr. J. Clark.

My cabinet and cabinet of Mr. Clark.

Diam. .24, Length .55, of an inch.

Remarks.—Two specimens are before me, which are precisely alike. It is a very remarkable species, having regular and close striæ over the whole of the lower whorls, between which striæ there is a double row of minute indented marks, very close to each other, and only visible with a lens. I have seen no such marks on any other species. In outline it is closely allied to *striatula*, (Nobis,) but it is a smaller species, and has not the cancellation of that species. The aperture is rather more than one-third the length of the shell. The outer lip is broken.

Melania Clarkii. Pl. XXX. Fig. 4.

Testâ plicatâ, claviformis, subtenui, tenebroso-fuseâ; spirâ elevatâ, attenuatâ; suturis subimpressis; anfractibus planulatis; aperturâ parvâ, subellipticâ, ad basim angulatâ, intus tenebrosâ; columellâ tortâ.

Shell folded, club-shaped, rather thin, dark-brown; spire elevated, drawn out; sutures somewhat impressed; whorls flattened; aperture small, rather elliptical, at the base angular, within dark; columella twisted.

Hab. Duck Creek, Tenn., Mr. Joseph Clark.

My cabinet and cabinet of Mr. Clark.

Diam. .23, Length .73, of an inch.

Remarks.—The form of this species is more attenuate than usual with the clavate forms. It has about ten whorls; those above the body whorl being disposed to be both plicate and striate. Towards the apex they are all thickly striate. On all the specimens before me, on the lower whorls, there are irregular oblique striæ, somewhat similar to those on the *M. Ocoeënsis*, (Nobis,) which give them a malleate character. On the upper margin of the whorls, along the sutures, there is usually an indistinct light line. The outer lip is broken.

Melania Brumbyi. Pl. XXX. Fig. 5.

Testâ striatâ, pyramidatâ, subcrassâ, rufo-bruneâ; spirâ valdè elevatâ, ad apicè carinatâ; suturis vix impressis; anfractibus planulatis; aperturâ subgrandi, rhomboidcâ, intus rubiginosâ; columellâ tortâ.

Shell striate, pyramidal, rather thick, reddish-brown; spire very much elevated, carinate at the apex; sutures but slightly impressed; whorls flattened; aperture rather large, rhomboidal, within rubiginose; columella twisted.

Hab. Coosa river, Alabama, Prof. Brumby. Huntsville, Alabama, Mr. J. Clark.
My cabinet and cabinets of Prof. Brumby and Mr. Clark.

Diam. .53, Length 1.72, of an inch.

Remarks.—This is a very remarkable species, and among the largest of our *Melaniæ*. In form and size it is allied to *annulifera*, Con., but may easily be distinguished by its more numerous striæ, its reddish colour, and the form of its aperture, which is more open. In the *Brumbyi* there is an angle in the middle of the whorl, which gives the aperture a rhomboidal form. The columella is rufous and the channel whitish. The apex of each of them being broken, the number of whorls cannot be correctly ascertained. I should suppose there were at least ten. Some of the specimens here are beautifully granulate between the striæ. The aperture is not quite one-fourth the length of the shell. Along the suture, on the upper part of the whorl, there is a line of a lighter colour than the other part.

I dedicate this species to Prof. R. T. Brumby, who has done so much in bringing to light the interesting shells of Alabama.

Melania oblita. Pl. XXX. Fig. 6.

Testâ valdè carinatâ, turritâ, cochleæformis, subtenui, corneâ; spirâ attenuatâ; suturis linearibus; anfractibus duodecim, acutè carinatâ; aperturâ parvâ, ellipticâ, intus albidâ; columellâ albâ tortâque.

Shell very much carinated, turreted, screw-shaped, rather thin, horn-coloured; spire drawn out; sutures linear; whorls twelve, acutely carinate; aperture small, elliptical, within whitish; columella white and twisted.

Hab. Tennessee?
My cabinet.

Diam. .30, Length .96, of an inch.

Remarks.—I have about a dozen of this species, which is very distinct from any with which I am acquainted. The locality I am uncertain about, the label being by some accident lost. I believe it comes from Tennessee, but am not certain. Its very marked character of a screw, or rather the end of a gimlet, strikes one at once. In most species there is a thread-like line above the carina and several below. The carina

is not usually persistent on the body whorl. It is nearest in form and size to *M. percarinata*, Con., but may be easily distinguished by the absence of granules between the carinæ, the length of the spire, having three or four more whorls, and in being less shining. The aperture is not quite one-third the length of the shell.

Melania furva. Pl. XXX. Fig. 7.

Testâ lævi, conoideâ, subcrassâ furvâ; spirâ subelevatâ; suturis excavatis; anfractibus planulatis; aperturâ parvâ, subrhomboideâ, ad basim angulatâ, intus purpureâ; columellâ purpureâ tortâque.

Shell smooth, conical, rather thick, dusky; spire rather elevated; sutures furrowed; whorls flattened; aperture small, subrhomboidal, at the base angular, within purplish; columella purple and twisted.

Hab. Branch of Coosa River, Alabama, Prof. Brumby.

My cabinet and cabinet of Prof. Brumby.

Diam. .30, Length .84, of an inch.

Remarks.—A single specimen of this species was received from Prof. Brumby. It has the apex so much eroded as to present only a little more than three whorls, which are, however, perfect, and enable me to distinguish it from its allied species, the nearest of which is *M. arata*, (Nobis.) The sutures have the same furrowed line, and the sides of the whorl are alike flattened. The aperture, however, differs in form and colour. In the *arata* the columella is straight down to the channel at the base; in the *furva*, it is curved to the right and the channel is less marked. The length of the aperture, in perfect specimens, must be about one-third the length of the shell.

The *Alexandrensis*, (Nobis,) from Louisiana, is very closely allied to this species, and when perfect specimens of both shall be obtained, they may possibly be found to be the same.

Melania Sellersiana. Pl. XXX. Fig. 8.

Testâ plicatâ, parvâ, conoideâ, subcrassâ, brunco-nigricente; spirâ subbrevi; suturis linearibus; anfractibus subconvexis; aperturâ magnâ, ellipticâ, ad basim rotundatâ, intus purpureâ; columellâ valdè incurvatâ.

Shell folded, small, conical, rather thick, very dark-brown; spire rather short; sutures linear; whorls slightly convex; aperture large, elliptical, rounded at the base, within purple; columella very much incurved.

Hab. Cany Fork, Tennessee, Mr. Coleman Sellers.

My cabinet and cabinets of Mr. Sellers and Mr. Anthony.

Diam. .16, Length .38, of an inch.

Remarks.—This is an interesting little species, somewhat like *M. Nicklíniana*, (Nobis,) in its general appearance and size, but is less inflated, and of a darker colour. It might be supposed that its being a plicate shell would at once distinguish it; but the *Sellersiana* seems to be very variable in the character of its folds, some of the specimens really having none remaining. These may have had folds near the apex, which is now eroded. Some of those before me are beautifully folded down to the last half of the body whorl, the folds being rather large and straight. The surface varies very much; some of the specimens being beautifully malleate, while on others no such marks can be observed. The outer lip is broken.

The apex being eroded in all the specimens, I am not sure of the number of the whorls; there may be about six. The aperture is about one-half the length of the shell.

I dedicate this species to Mr. Coleman Sellers, of Cincinnati.

Melania oppugnata. Pl. XXX. Fig. 9.

Testâ lævi, truncatâ, cylindraceâ, percrassâ, luteo-corneâ; spirâ truncatâ; suturis magnis et valdè irregulariter impressis; anfractibus valdè compressis, supernè geniculatis; aperturâ prælongâ, valdè constrictâ, supernè callosâ, intus albâ; columellâ tortâ, supernè valdè incrassatâ.

Shell smooth, truncate, cylindrical, very thick, yellowish horn-colour; spire cut off; sutures large and very irregularly impressed; whorls very much compressed, geniculate above; aperture very long, very much narrowed, above callous, within white; columella twisted, and very much thickened above.

Hab. Alabama river, Mr. C. M. Wheatley.

My cabinet and cabinet of Mr. Wheatley.

Diam. .41, Length —— ?

Remarks.—This is a very remarkable species. The two specimens before me are both cut off, leaving little more than the body whorl. When taken they were evidently living and healthy specimens, but the eroded and fractured spires give them the appearance of old and diseased shells, which is by no means the case. The upper part of the whorl, along the suture, is irregularly fractured round the whole circle. This arises from the fact that the animal having filled up the channel with calcareous deposit, suddenly recommences at a new line of growth, some distance below, leaving open and bare of epidermal matter this upper portion of the channel, which consequently having a sharp edge, becomes more or less fractured. The whorls are so much flattened that the two sides are nearly parallel. One of the specimens has a small spot of brown in the aperture above and below—the other has none. This species is allied to *auriculaformis*, (Nobis,) on one side, and *olivula*, Con., on the other, but it may be easily distinguished from both of them. The former is a smaller shell and more fusiform; the latter is more conical, less thickened on the columella, and not irregularly fractured in the suture. The number of whorls or proportional size of the aperture cannot be ascertained on the specimens before me. They have the appearance of having been very much exposed to an attacking enemy, hence the name.

Melania Saffordii. Pl. XXX. Fig. 10.

Testâ lævi, obtuso-conoideâ, crassâ, subfusiformis, tenebroso-viridi; spirâ subbrevi; suturis linearibus; anfractibus convexiusculus, ultimo magno; aperturâ subgrandi, ovato-productâ, intus purpureâ; columellâ purpureâ tortâque.

Shell smooth, obtusely conical, thick, subfusiform, dark-green; spire rather short; sutures linear; whorls a little convex, the last large; aperture rather large, ovately elongated, within purple; columella purple and twisted.

Hab. Lebanon, Wilson county, Tennessee, Mr. James M. Safford.

My cabinet and cabinet of Mr. Safford.

Diam. .37, Length .85, of an inch.

Remarks.—This is a very distinct species, with a not uncommon form. The green colour is unusual. On the upper part of the whorl, and on the line of the suture there is a light or brownish band. The body whorl is rather suddenly enlarged in the middle, which gives it a slight gibbous appearance, and it is irregularly transversely striate. The apex of each of the three specimens under my examination being eroded, the number of whorls cannot be exactly ascertained, but I think there must be about six. The aperture is quite one-half the length of the shell. It is allied to *M. sordida*, (Nobis,) in outline, but may easily be distinguished in colour and the gibbous swelling on the whorls. I name this after Mr. Safford, to whose kindness I owe this and some other fine specimens from Tennessee.

Melania pinguis. Pl. XXX. Fig. 11.

Testâ lævi, inflatâ, subrotundâ, percrassâ, tenebroso-fuscâ; spirâ obtuso-conoideâ; suturis impressis; anfractibus convexiusculus; aperturâ magnâ, rotundatâ, intus vel albâ vel purpureâ; columellâ incurvâ, incrassatâ.

Shell smooth, inflated, almost round, very thick, dark-brown; spire very obtusely conical; sutures impressed; whorls a little convex; aperture very large and rounded, within either white or purple; columella incurved and thickened.

Hab. Lebanon, Wilson county, Tenn., Mr. J. M. Safford.
My cabinet and cabinet of Mr. Safford.

Diam. .34, Length .53 of an inch.

Remarks.—I have three specimens before me from Mr. Safford; two of them are purple within and one white. None of them are perfect on the apex, but I presume that the number of whorls must be five. One of the specimens has four. In outline it is very much like *M. inflata*, (Nobis,) but it differs totally in the form of the columella. In that species the columella is twisted backwards, and makes an angular oblique channel—in the *pinguis* it is regularly curved, with scarcely a perceptible indentation in the place of a channel. The aperture is fully one-half the length of the shell.

Melania gibbosa. Pl. XXX. Fig. 12.

Testâ lævi, parvâ, obtuso-conoideâ, gibbosâ, subfusiformi, subtenui, virido-corneâ; spirâ obtusâ; suturis irregulariter impressis; anfractibus quinque, subconvexâ: aperturâ magnâ, elliptieâ, intus bivittatâ; columellâ rubiginosâ, incrassatâ, planulatâ, impressâ et valdè curvatâ.

Shell smooth, small, obtusely conical, gibbous, subfusiform, rather thin, greenish horn-colour; spire obtuse, sutures irregularly impressed; whorls five, somewhat convex; aperture large, elliptical, within double banded; columella rubiginose, thickened, flattened, impressed and much curved.

Hab. Scioto river, Ohio, Mr. C. M. Wheatley.
My cabinet and cabinet of Mr. Wheatley.

Diam. .25, Length .43, of an inch.

Remarks.—This is a small, very remarkable species. There is a slight depression above the middle of the whorl, which gives it a somewhat gibbous form. The most unusual character pertaining to this species is, however, the very flat and impressed columella,

more impressed at the point of the umbilical region. The columella on the upper part of these two specimens is not thickened, but it is of a dark-brown colour, and being also dark below, the colour extends to the outer side of the whorl, and there makes two rather indistinct bands. In outline it is allied to *M. fusiformis*, (Nobis,) but they differ entirely in the columella and in the length of the aperture. The aperture is rather more than one-half the length of the shell.

I have had some doubts of the Scioto being the real habitat of this shell; but Mr. Wheatley says it was sent from thence to him. It seems to have a more southern aspect.

SYSTEMATIC INDEX.

Basistoma Edwardsii, ... Page 296
Melania Brumbyi, ... 298
" Clarkii, ... 297
" furva, ... 299
" gibbosa, ... 301
" oblita, ... 298
" oppugnata, ... 300
" perstriata, ... 296
" pinguis, ... 301
" Saffordii, ... 300
" sculptilis, ... 297
" Sellersiana, ... 299

ARTICLE XX.

Description of a New Species of Helix, from California, and a new Characteristic Form of certain American Colimaceæ. By Isaac Lea. Read March 5th, 1852.

Helix Leconti. Pl. XXX. Fig. 13.

Testâ plano-convexâ, infernè convexâ, papillosâ, bruneo-corneâ, latè umbilicatâ, tridentatâ, intus columnâ accessione instructâ; anfractibus senis; aperturâ subrotundatâ, constrictâ; labro hipatico, reflexo, bidentato; columellâ uno-dentatâ.

Shell plano-convex, convex below, papillose, brownish horn-colour, widely umbilicated, three toothed, furnished with an accessory column within; whorls six; aperture rounded, constricted; outer lip dull-brown, reflexed, two-toothed; columella one-toothed.

Hab. St. Francisco, J. L. Le Conte, M. D.
My cabinet and cabinet of Dr. Le Conte.

Diam. .27, Length .15, of an inch.

Remarks.—This is a very beautiful little species, which is allied in some of its characters to *hirsuta*, Say, *inflecta*, Say, and *Leai*, Ward. It is about the size, outline and colour of the last, and the umbilicus is of the same size. It differs, however, in the teeth, the *Leai* having none on the outer lip; and in the papillæ, which are smaller, rounder and closer in the *Leai*. The tooth on the columella is alike in both, being long, white, and incurved. Like the *inflecta*, it has two teeth on the outer lip, but these are much larger and whiter in the *inflecta*, which differs also in having the umbilicus closed, and in the papillæ being less distinct. In colour it is like a brown *hirsuta*, but it differs in being smaller, in being umbilicate, and in having two teeth on the outer lip, instead of a sinus, as in *hirsuta*, which has a much larger tooth on the columella, and a much more constricted aperture.

Fig. 13, b represents the papillæ enlarged.

Neither of the few specimens brought by Dr. Le Conte has the animal alive, which, of course, will remain yet to be described. The papillæ cover the whole surface. On the upper portion of the whorls they are close and elongate, passing into the form of striæ. On the lower portion they are more rounded and beautifully displayed. It is very probable that in some very perfect specimens, they may be found to have a hirsute character.

I dedicate this species to Dr. Le Conte, whose enterprising researches in California have brought to our knowledge many new forms in other branches of natural history.

ARTICLE XXI.

On the Fossil Foot-Marks in the Red Sandstones of Pottsville, Schuylkill County, Penna. By Isaac Lea. Read April 2d, 1852.

When I communicated to this society, in 1849, the discovery of "foot-marks" of a Saurian animal in the "red shale" formation, No. 11, of Prof. H. D. Rogers, near Mount Carbon, south of Pottsville, I mentioned that in characterizing and naming this new animal (*Sauropus primævus,*) I would at a future time offer to the society a more lengthened and accurate description, with correct figures of this remarkable and interesting specimen. A subsequent visit to the locality has not induced me to change my views as to its position in the series of the stratified masses of that district.

After the discovery of this ancient Saurian had been made known, by my account of it in the Proceedings of this society, Prof. H. D. Rogers stated, at the meeting of the "American Association for the Advancement of Science," at New Haven, that these "foot-prints in the red shale formation at Mount Carbon" were "of an age essentially later than that attributed to them,"—that "they occurred in a geological horizon only a few hundred feet below the conglomerate which marks the beginning of the productive coal series, in which series similar foot-prints, attributed to batrachian reptiles, have been previously met with in Western Pennsylvania. Instead, therefore, of constituting a record of antique reptilian life, earlier than any hitherto discovered, by at least a whole chapter in the geological book, they carry back its age only by a single leaf."

These and some farther observations were followed by remarks of Prof. Agassiz on the character of these foot-prints, which he attributed rather to "the pectoral and ventral fins of fishes of an ancient type, which probably had some power of locomotion out of water."*

At the meeting, in August, 1851, at Albany, Professor Rogers exhibited specimens which he had procured from the same formation, (No. 11,) near to the same locality.

* Proceedings of the American Association, 1850, p. 251.

These consisted of some of the same kind of "foot-prints, with others of a very different form, and these were accompanied by more perfect specimens of impressions of plants than had before been discovered. These were of great interest, as their structure indicated their being "air plants." The Professor named them *Plumites*. He also mentioned that he had found *Stigmaria* in the "*red shale*" of formation No. 11. Prof. Agassiz subsequently remarked on these tracks, and objected to any of them being considered as made by "reptiles." He did not believe that any of them were made by air-breathing animals; that these "*trails*" could not be made by "*reptiles*," but that they must have been made by "*annilids* or *fish*," and most probably by "*Articulata*." He farther stated that in his belief no air-breathing animal had been found even as low as the New Red Sandstone.

Without disputing such authority as that of Prof. Agassiz, I shall hold to my own opinions, as expressed in my former communication, as to the fact of these "*foot-marks*" being impressed by a four-footed, air-breathing animal, allied to the "Saurians," having four toes on the hind foot and five on the fore foot. As regards the opinion of there having been no air-breathing animals in existence as low as the New Red Sandstone, it appears to me to be fully answered in the negative by the existence of the *Chirotherium*, (*Labyrinthodon*, Owen,) *Thecodontosaurus*, &c., in that formation in Europe, and by the recent discovery of the bones and teeth of a *Sauroid* animal in the New Red Sandstone of Lehigh county, Penna., announced by me in the Proceedings of the Academy of Natural Sciences, last year, and which I named *Clepsysaurus Pennsylvanicus*.

As regards the observation of Prof. Rogers, that the "foot-prints" at Mount Carbon were "of an age essentially later than that attributed to them" by me, I would reassert that what I then stated was correct, that is, that they existed in his "red shale formation," No. 11, of his Pennsylvania survey. There is no error, as implied by Prof. Rogers' communication, in this fact; the position of the "foot-marks" is undeniable. The difference is simply whether formation No. 11 be part of the "*Old Red Sandstone formation*" or not. It was my opinion, with that of most of our geologists, that in the Pennsylvania Reports, when the term "red shale formation," No. 11, was used to designate a "period" two "formations" below the coal measures, (For. 13,) the *Old Red Sandstone*, analogous to that of Europe, was considered to be understood.* The late Richard C. Taylor, whose authority, on the geology of this state was inferior to none other, was said by Prof. Silliman, Mr. Hall and others, to have been the first person in this country who had referred the Old Red Sandstone underlying the coal of this state, to its true position, correspond-

* The position of Prof. Rogers' "red shale formation," (No. 11,) is thus described by him:—"A very brief description will, for the present, suffice to designate the range of the red shale formation. Encircling in a continuous zone all the anthracite coal basins of the state, it usually constitutes a chain of deep and narrow valleys enclosed between the ridges of Formation No. X. on the one side, and on the other, those containing Formation No. XII., composing the margin of the coal measures."

"The maximum thickness of this formation occurs, apparently, in its south-eastern belt, or that which ranges along the south side of the southern anthracite coal basin. From accurately conducted measurements made at Pottsville, the depth of the stratum at that place is about 2,949 feet."—*Second An. Report, p.* 66.

"Formation No. XII." he designates as "conglomerates and sandstones immediately below the coal measures of the Anthracite, the Broad Top and the Allegheny coal regions," which, at Pottsville, he makes 1031 feet.

ing with its place in the series of European rocks; and Mr. T. always considered For. No. 11 as the "*upper series of the old red sandstone.*" In his paper on the "Carboniferous Series of the United States," (Mag. of Nat. Hist., vol. 9, 1836,) he makes the Old Red Sandstone which underlies the coal formation of Pennsylvania, equivalent to that in Europe. He does not agree with Mr. Weaver in his views regarding this red sandstone. Mr. Taylor arranges these rocks thus:—

1. The (almost) horizontal carboniferous series. This includes the conglomerate on which the series is unquestionably based.

2. "The Old Red Sandstone and Red shales, many thousand feet thick,"—nearly vertical, in central Pennsylvania—pass immediately beneath the bituminous coal field of Pennsylvania, in Tioga county.

3. The upper transition and grauwacke series commences at the termination of the red shales and sandstones.

He states that the "diagrams which have been laboriously worked out, exhibit no limestone in Pennsylvania between the secondary coal series and his Old Red Sandstone group, which average a mile thick." And again he says, "I see that both in the acknowledged secondary bituminous coal region, and in those of the anthracite districts, the carbonaceous deposits are alike based on red sandstones and red shales."—Always considering these red sandstones as equivalent to the *Old Red Sandstone* of Europe.

In the New York reports, Mr. Hall considers "No. 11 of the Pennsylvania Survey" as equivalent to the "Old Red Sandstone," both of which he refers to the "Catskill group." (Part IV., Geology, p. 278.) In the diagram on the same page, he represents the *Old Red Sandstone* as immediately underlying the conglomerate which again underlies the "coal measures of Pennsylvania." In his annual report, 1840, p. 394, he says that "this rock (Old Red Sandstone) forms the limit between the Silurian and Carboniferous system, and may be regarded as one of the most important of the whole series;" and he gives Mr. Taylor the credit of pointing out the existence of this rock and its analogy to the Old Red Sandstone of Europe. In his geology, part 4, p. 516, he enforces this opinion by saying, "there remains no doubt but the sedimentary rocks of New York correspond with those of the Silurian and old red systems, as described in the *Silurian Researches.* If the Devonian is to be regarded as a distinct system, we shall find its representative in the Chemung and Portage groups, with, perhaps, a part of the Hamilton group." Mr. Conrad too, recognises the *old red system* in his table of Formations, and places the "Old Red Sandstone," of Blossburg, Penna., immediately above the Ludlow rocks of the Silurian system. (American Journal, vol. 38, p. 89.) And in his report of 1841, when mentioning the Devonian group, he says, that "great tracts of this system lie between Carbondale in Pennsylvania, and the upper Silurian district of New York, nearly all of which is quite destitute of organic remains, except those of vegetables. (p. 42.) Dr. Emmons and Mr. Vanuxem seem, in their reports, to recognise the Catskill group as being analogous to the Old Red Sandstone of Europe, and that it immediately underlays the great coal formation of Pennsylvania. These inosculating strata have always presented difficulties to the geologist, and Mr. Vanuxem, when mentioning the differences of opinion, as to the

"coal formation" being classed with the transition or secondary rocks, says, "this has always been debateable ground. (N. Y. Reports, p. 13.) And farther on, when speaking of the coal-bearing rocks, he says they commence "at the top of the Devonian or the Old Red Sandstone and Catskill group." (p. 14.)

It was not until the meeting of the American Association of August last, that I was aware of there being a doubt in the mind of any American geologist of the Old Red Sandstone of Europe having its analogue in the United States. Professor Rogers then remarked, that he "did not admit the red sandstone of this epoch to be the *Old Red Sandstone* of Europe," and he denied that "the Old Red Sandstone existed in the United States at all." This opinion is at variance with that of all the American geologists, so far as I know, and that of the two most distinguished European geologists who have examined, with great care, the extended palæozoic strata of the United States, Verneuil and Lyell.* The latter, in his Travels, (vol. 2, p. 255, and in his Map,) makes the Tully limestone (No. 25,) the Genesee slate, (No. 26,) Portage group, (No. 27,) and Chemung group, (No. 28,) to embrace the Devonian period. And in another place he says, when describing the Tioga coal field, that "beneath the millstone grit are those red and gray sandstones already alluded to, as corresponding in mineral character, fossils and position with our "Old Red." (Vol. i., p. 62.) Verneuil embraces a wider extent for the Devonian, and begins it with the Oriskany sandstone, (No. 18,) and terminates with the Catskill group, (No. 29.) This wide range includes Formations 7, 8, 9, 10 and 11 of the Pennsylvania Survey. And in regard to the high authority of the palæontologist of the New York Survey, M. Verneuil says, "we have had occasion to recognise the exactness of the observations of this able geologist, and we only differ from him in opinion upon the age and the true equivalents of the black bituminous shales and of the principal mass of the micaceous sandstones which overlie them in the states of Ohio, Indiana and Kentucky." Am. Journ., vol., v. p. 182.) Mr. Hall says, the Devonian system "comprises the five superior groups of the Helderberg division, the six groups of the Erie division, and the Old Red Sandstone." (Am. Journ., vol. 5, p. 366.) And he farther says, "It is incontestable that the red sandstone which forms its superior part, and which is so powerful on the frontiers of the states of New York and Pennsylvania, is upon the same horizon as the Old Red Sandstone of Scotland and Wales." (p. 367.)

* M. Verneuil, in his Memoir "sur la Parallélisme des Dépots Paléozoïques," places the Catskill group (which he designates as No. 28, but which is really No. 29 of Mr. Hall's Table,) in the Devonian system, and calls it "Vieux grès rouge." After his remarks on Nos. 26 and 27 of the New York Reports, he says, "Pour terminer cette revue rapide de la série paléozoïque de l'États de New York il ne nous reste qu'à dire quelques mots des masses puissantes de vieux grès rouge qui forment les montagnes de Catskill, et qui, se prolongeant le long de frontières de la Pennsylvanie pénétrent dans l'interieur de cet État. . . . ou l'on trouve quelquefois des fragments de poissons analogues à ceux du vieux grès rouge d'Ecosse et de Russie tels que l'Holoptichus noblissimus." (page 17.)

The able palæontologist, Mr. Sharpe, who examined, compared and tabulated the palæozoic fossils taken from this country by Sir Charles Lyell, considers the Old Red Sandstone of the "New York system to close with the Chemung group, which is surmounted by a formation of sandstone, considered identical with our Old Red Sandstone." (Proceedings Geol. Soc., vol. 4, p. 155.)

I am not disposed to undervalue the difficulty which exists in dividing the carboniferous system from that which immediately underlies it. It is and has been "debateable ground." But in placing these Pottsville "foot-marks" in the "red shale formation, No. 11," and then considering, with many other geologists, that Formation No. 11 was the Devonian or upper portion of the Old Red Sandstone, it never occurred to me that the place of these "ancient foot-prints" could be converted into the appearance of a geological error, when I expressly stated they were found near Mount Carbon, in the "red shale Formation, No. 11," of Prof. Rogers. And when he says, that they "are of an age essentially later than that attributed to them," and but a few hundred feet below the conglomerate, (For. 12,) which marks the beginning of the productive coal series, in which similar foot-prints, attributed to batrachian reptiles, have been previously met with in Western Pennsylvania,* an erroneous impression has been made on the minds of geologists, that I had made a mistake in the geological position of the foot-marks, and it is to this point I wish to draw the attention of the geologist, viz., that I gave Prof. Rogers' own nomenclature to the rock, "red shales," ("Formation No. 11,") and stated it to be about 1730 feet below the coal formation, (No. 13.) which Formation according to his measurement, was 6750 feet thick at Pottsville. Taking, then, his measurement, I presumed these "foot-marks to be about 8500 feet below the upper part of the coal formation there." The very interesting "foot-marks" discovered by Dr. King, being near to the *upper portion* of the Coal Formation in the vicinity of Greensburg, Penna., are very essentially removed and later, by two Formations, according to the Table of Formations of Prof. Rogers himself, and must therefore carry back the existence of an air-breathing animal, not, as he stated, that "they carry back its age only by a single leaf," but by *two Formations*,—that is, from Formation No. 13 back to Formation No. 11, leaving the great conglomerate Formation No. 12, interposing its mass, 1031 feet, and descending below its lower limits 700 feet, into the "red shale," (For. 11.)

As to the difference of opinion between Prof. Rogers and the able geologists quoted above, regarding this "red shale formation," whether it be the equivalent of a part of the Devonian (upper portion of the Old Red Sandstone,) or not, it is a matter of little moment in this case. That is a question to be definitely settled when we get more palæontological evidences, and when we obtain more of the organic remains of this "*red shale*," (For. 11,) in which I was fortunate enough to have observed the distinct trace of the oldest "air-breathing animal," then known in the sedimentary rocks of the globe. Without more records of the organisms of existing life at the epoch of this "*Red Shale Formation*," assured analogies cannot be established; and a difference of opinion may reasonably exist at the present time, as to the equivalents of the masses in Europe with ours on this side of the Atlantic; but in the total absence of the Old Red Sandstone I should not concur with Prof. Rogers.†

* By Dr. King, in Formation 13.

† In regard to their line of division, Mr. Hall very judiciously remarks, that the separation between the carboniferous and lower deposits is far from being well defined, and not as well ascertained as the separation "between the Devonian and Silurian.' (Am. Journal, vol. 7, p. 47.)

M. Verneuil considers that "if in two countries, a certain number of systems characterized by the same fossils, are superimposed in the same order, whatever may be the thickness or number of the physical groups of which they are composed, these systems should be considered as parallel and synchronous." (Geol. Soc. Proc., vol. 4, p. 103.)

I am aware that Prof. Rogers would arrange all the rocks, from the Potsdam sandstone inclusive, to the top of the coal rocks, in one "system," of about 30,000 feet in thickness, characterized by peculiar organic remains, marking a long series of events, and a vast lapse of time. He said, in his address of 1844, "we behold one uninterrupted succession of deposits, closely linked by an unbroken sequence of animal and vegetable remains;" that they "constitute a single system, the entire record of one immense continuous period, the collected gatherings of one prodigious sea." (Pages 19 and 20.)

In these views I should not be disposed to go to the entire length. I am aware that in Europe there is a great difference of opinion among the most able geologists. Sir Charles Lyell now repudiates the theory of "*successive development of organic life*," and advocates the wide field of "*uniformation*," which an able writer in a late Number of the London Quarterly Review has most vigorously attacked and apparently settled.

For the present it might be safest to view the divisions of the more ancient rocks as forming two systems—the older and newer Palæozoic rocks—and make the separation at the Devonian (old red sandstone,) including it in the newer Palæozoic rocks, which would then embrace also the Carboniferous Limestone, the Conglomerate, the Coal measures, and the Lower New Red Sandstone or Permian. The older Palæozoic rocks would embrace all the ancient sedimentary rocks below the Devonian. These are the views of Prof. Forbes and other geologists, and they seem to me to be more nearly in accordance with the present state of our knowledge of the strata and their organic contents.

Having, I trust, vindicated myself in regard to the geological position in which I had placed these remarkable "foot-prints," I shall proceed to regard some of their analogies, and then give a more extended and accurate diagnosis of the imprints themselves, than I did in my former communication, published in the Proceedings of this society, vol. 5, p. 91.

When Cuvier was engaged in fossil osteology, fossil *foot-prints* had not been observed; but he remarked that the print of a foot clearly indicated the form of the teeth and the bones which leave a mark. The first of these curious relics seems to have been observed in Scotland, by Dr. Duncan, at Dumfriesshire, in the *New Red Sandstone*. These were made, it is believed, by *tortoises*. Very shortly after this, the tracks of the *Cheirotherium* were observed, in Saxony, in the same formation, and Dr. Dean and Professor Hitchcock, in the *New Red Sandstone*, in the valley of the Connecticut river, observed various "foot-marks," nearly all of which they attributed to *birds*, some being of gigantic size. In 1836 Prof. Hitchcock published an account of these *Ornithichnites*, in the American Journal of Science, and many valuable papers have been published since by him, by Dr. Deane and others. The two most important ones are those in the Transactions of the American Academy, by Prof. Hitchcock, in vol. 3d, and by Dr. Deane, in vol. 4th. The Professor considered that he had made out forty-nine species, twelve of which were quadrupeds; four probably lizards; two Chelonians, and six Batrachians. The figures which he gives

of the genus *Anisopus* allies them to *Cheirotherium* and the figures of Dr. Deane, although evidently different, still have some analogy to the same genus.

These interesting discoveries had not long been made before the scientific world was informed of equally important quadrupedal imprints having been observed in the rocks of the Coal Measures, a Formation considerably lower in the series. In October, 1843, Sir Charles Lyell, in a paper communicated to the American Journal of Science, stated the fact that Mr. Logan had discovered in the "rippled marked sandstones" of Horton Bluff, Nova Scotia, "foot-steps which appear to Mr. Owen to belong to some unknown species of reptile, constituting the first indications of the reptilian class known in the carboniferous rocks," vol. 45, page 358. Von Meyer, early in 1844, added to the Fauna of the coal Formation a new reptile which he called *Apateon pedestris*, the complete skeleton of which he obtained at Münster-Appel, in Rhenish Bavaria. Towards the latter part of the same year, Dr. King, of Greensburg, Penna., published an account of the imprints discovered by him in Westmoreland county, in the sandstones of the Coal Measures, near to the surface of that formation, (No. 13, Penna. Survey.) This appeared in the Proceedings of the Academy of Natural Sciences, December 17, 1844. These "Foot-marks consisted of those of a bird and two "*Saurian reptiles*," and were stated to be "near 800 feet beneath the topmost stratum of the coal formation." These were subsequently visited and examined by Sir Charles Lyell, who considered them to belong to the genus *Cheirotherium*. Prof. Hitchcock described *Thenaropus heterodactylus* of Dr. King under the impression of its being Batrachian. The tracks, I think, were made by a Sauroid animal. Subsequently to these discoveries, in 1847, Prof. Von Dechen observed in the Coal Formation of the Saarbrück district several remains of a peculiar genus, which Dr. Goldfuss described under the name *Archegosaurus Decheni*, and at the same time stated that he considered it as "a crocodilian animal, forming a transition to the lizards, in consequence of the presence of a parietal foramen." After this, Dr. Goldfuss added two other species to this genus, *A. medius* and *A. minor*. The largest of the three, the *Decheni*, was supposed to be about three feet six inches long, and on a further examination he considered the genus to belong more to the *Labyrinthodonts*, (Cheirotherium,) of the Trias than to the crocodiles. "The peculiarities of the skeleton correspond to those of the skin, which consisted of long, narrow, wedge-shaped, tile-like, horny scales, arranged in rows, which meet on the ventral side in *Archegosaurus Decheni* at right angles, in *A. medius* in a curve." Von Meyer considered that the *Archegosaurus* was nearly allied to the *Labyrinthodonts*, which Sir Richard Owen had considered as *Batrachians*. These Von Meyer was now inclined to believe were rather *Saurians*. It is said that Owen is lately disposed to consider the *Labyrintholonts* as *Saurians* arrested in their development; page 55.* In January of the present year, a memoir on the discovery of fossil foot-steps by Captain Brickenden, and of a reptile, by Patrick Duff, Esq., and described by Dr. Mantell, was presented to the Geological Society of London. The specimen discovered by Mr. Duff was "a small four-footed reptile, not exceeding six or seven inches. A distinct impression of a

* M. Jager says that the *Pygopterus lucius* of Agassiz is not a fish, but a reptile, and the same as *Archegosaurus Decheni*. (Geol. Soc. Journal, vol. 7, p. 34.)

great part of the skeleton, with a mutilated portion of the cranium." Its osteological characters are said to be "peculiar, exhibiting a blending of the true lacertian with batrachian attributes." Dr. Mantell has named it *Telerpeton Elginense*. He also laid before the society specimens of fossil ova which he considered to be unquestionably ova of batrachian reptiles. (An. and Mag. of Nat. Hist., Jan., 1852.)

Impressions in the plastic clay and sand of the shores of ancient lakes or rivers, left by the inhabitants of their borders had been thus observed in the Coal Measures and the superimposed strata, as well also their bones. When, in April, 1849, on a visit to the coal district of Pottsville, Schuylkill county, Penna., I was fortunate enough to have observed the "Foot-prints," in bas relief, of a *reptilian quadruped*, in the Red Sandstones of the eastern slope of Sharp Mountain, where the river Schuylkill makes its pass through that range of mountains, an account of which I communicated to the American Philosophical Society in June, 1849. (See Proceedings, vol. 5, p. 91.) Its position was on the west side of the turnpike road, about a mile east of the town of Pottsville, and a few hundred feet east of Mount Carbon Hotel. The massive sandstone rocks here are of a beautiful red colour and fine texture, evidently formed of sand and clay which had passed through much attrition. The colour is due to a considerable charge of the red oxide of iron. Minute spangles of mica are generally interspersed throughout these rocks, and assist in giving the surface of the fractures a soft and almost satin-like texture. The strata here are tilted somewhat over the perpendicular, by the upheaval of this range of mountains; but the surfaces which are exposed bear evidence of these sedimentary rocks having been deposited in a nearly horizontal position, in a placid state of water, presenting to the animal a very slightly inclined shore, as it advanced from the waters which existed on the northern side. The impressions made at that time were upon the sands of a shore from which the waters had for a time receded, having left the shore covered with well defined "ripple marks," and a profusion of "rain-drop pits." The surface of the rock exposed to view was about six feet by twelve, and across the shorter diameter were distinctly and beautifully impressed a double row of tracks, consisting of six impressions, duplicated by the hind foot falling into the impression of the fore foot, but a little more in advance. The specimen taken from the mass of the rock was thirty-four by twenty-one inches. The six *double impressions* show, in the two parallel rows, formed by the left feet on the one side and the right feet on the other, that the animal had five toes on the fore foot, three of which toes were apparently armed with unguical appendages. The hind feet appear to have had four toes. The impression of the hind feet being made nearly on the same spot as that of the fore feet, cause some obliteration and confusion, as well as variation in size and form of the "foot-marks.' The best defined one is four and a half inches long and four broad—this is including the double impression. The single foot would probably measure three and a half inches long by three inches broad. The stride or step of the animal measures, from toe to toe, thirteen inches; from outside to outside, the distance is eight inches. The mark of the tail is distinctly impressed, causing a groove-like furrow on the top of each ripple line, oblique to their direction, and generally five to six inches long and three-quarters of an inch wide. There are four of these tail-

marks or grooves on as many ripple lines, the crests of which lines are elevated about half an inch above the intermediate depressions. The tail was evidently not a thick one, and the animal must have had a distinct and perfect step, and not a half swimming motion, as in the crocodilians, there being no trace of the dragging of the feet. The tail must have been considerably elevated, as the alternate tail-impressions show that a vibration actually took place at every step, the four grooves not being in a direct line, but each one approaching its nearest "foot-mark" to the right or the left, alternately, and therefore never precisely on the central line between the two rows of the foot-marks. These facts prove that the animal which left its imprint in this ancient sandstone stood much higher on its legs than the *Crocodilus* or the *Monitor*, and likely was not so long in proportion to the size of the feet. It is well known that the *alligator* leaves no foot impression in the mud, but simply a large furrow, made by the ventral and caudal portions. The form of the foot impressions are, however, very similar to that which is received by the mould in clay of the *Alligator Mississippiensis*, specimens of which are in the collection of the Academy of Natural Sciences of Philadelphia. If an opinion might be hazarded as regards the probable size of the animal, based on this meagre diagnosis, I should suppose it might reach as much as seven or eight feet in length.

The "ripple-marks," as observed before, covered the whole surface of the exposed part of the rock, six by twelve feet. Their crest-lines are generally seven or eight inches apart, and they swell up gently in nearly parallel lines, but falling off and recommencing again, give an irregular appearance to the surface, but which is altogether harmonious.

The "rain-drop pits" are rather large and nearly round, showing a tranquil state of the atmosphere when the rain descended. They covered the whole surface, and are not very deeply impressed.

In regard to the geological position of the "foot-marks" of this reptilian quadruped, having had no reason to doubt my former views, originally expressed in the Proceedings of this Society, I shall state it here nearly in the same words. The discovery was of great interest from the fact that no such animal remains had before been discovered so low in the series. Those described by Dr. King, in the great western coal-field, which naturally created great interest, are only eight hundred feet below the surface of the coal formation. (No. 13, of Prof. Rogers.) The position of the Pottsville "foot-marks" is about 8500 feet below the upper part of the coal formation there, which is 6750 feet thick, according to Professor Rogers, and they are in his "Red Shale Formation," (No. 11,) 2949 feet thick, the intermediate silicious conglomerate (No. 12,) being stated by him to be 1031 feet thick at Pottsville. These measurements would bring these foot-marks about seven hundred feet *below the upper surface* of this "Red Shale Formation," (No. 11,) which is the *Old Red Sandstone* of Mr. Taylor, Mr. Hall and other geologists of the New York Survey,* and now known as the Devonian of Sedgwick and Murchison. It has been well

* See R. C. Taylor "On the Carboniferous Series of the United States;" "Report of the Dauphin and Susquehanna Coal Company;" "Geological Chart of the Silurian Rock Formations of North America," MSS. 1847, in the Library of Acad. of Nat. Sci., &c., James Hall, "Geology of New York," Part 4, pp. 278, 516, &c., and other of these New York Reports.

known that this formation encircles entirely in a peculiar manner, all the three anthracite coal basins of Pennsylvania, and Prof. Rogers so describes it, stating that "it is enclosed between the ridges of Formation No. 9, on the one side, and on the other, those containing Formation No. 12, composing the margin of the coal measures." (2d Report, p. 66.) He describes "Formation No. 12," as "conglomerates and sandstones immediately below the coal," and states it to repose on the "Red Shale Formation," (No. 11,) p. 67.

A mass of coal plants exists immediately on the northern face of the heavy conglomerate, here tilted ten degrees over the vertical, and forming the crest and "back-bone" of Sharp Mountain. This conglomerate mass is about one hundred and fifty feet thick at the western side of the road, below Pottsville. On the same road-side, about 1735 feet from these coal plants, is the face of the rock bearing these "foot-prints," tilted slightly over the vertical, and facing the north. It is proper to state, that the limestone of the Old Red Sandstone exists here about two feet thick, and underlies these "foot-prints" sixty-five feet.

Sauropus primævus. Pl. XXXI.

Feet pachlydactylous. Anterior ones armed with five toes. Divarications of the first and second toes = 60°; of the second and the third, = 50°; of the third and the fourth, = 40°; of the fourth and the fifth, = 40°. Impression of the toes too much confused to measure correctly, varying from one and a half to two inches long. Length of the foot about three and a half inches. Breadth about three inches. Distance from the point of the first to the second toe, 1.9 inches; from the second to the third, 1.4 inches; from the third to the fourth, 1.2 inches; from the fourth to the fifth, 1 inch. Posterior feet armed with four toes. Divarications of the first and second, = 40; of the second and third, = 35°; of the third and fourth, = 50°. Length of the toes not ascertainable, owing to their obliteration by its impact with the impression of the anterior foot. Track of the posterior foot in a line and directly in advance of the anterior foot. The stride or step from toe to toe, 13 inches; from outside to outside, 8 inches. Length of the tail-marks, about 5 inches; breadth, three-quarters of an inch.

Plate XXXII.

This presents a reduced view of the slab, which is thirty-four by twenty-one inches, or rather less than one-fourth the natural size, and displays the regularity of the steps in a double row, as well as the librating tail-grooves, and the ripple-marks.

Plate XXXIII.

In my former communication to this society, I mentioned that there were other remains of organized matter in this rock. Obscure impressions of plants, small spots, with filamentous radiations and reed-like marks had been observed. In many places on the surface of the rocks, I observed rough nodules, concretionary masses, which I have since concluded may be fossil ova of batrachian reptiles. They are irregular ovoid bodies, and usually in pretty close approximation. In the specimen before me, the water in passing over these left lines indicating its direction. (Fig. 2.) Occasionally may be seen small

subglobular forms, which may possibly be the ejectamenta or coprolites of some of the animals that passed over the shores of these waters.

Another of the specimens which I obtained at the same time, contains the remains of a portion of an organic form, which I cannot with any satisfaction make out. It is probably a very small portion of the whole organism, as it forms only a short, curved, serrated line of an inch and half in length. (Fig. 1.) I cannot compare this serrated line to any like form, but that of the serrated edge on the side of the *Olenus asaphoides*, of Hall's Palæontology, (part 4, pl. 67, fig. 2,) and *Asaphus Buchii*, in the Llandeilo Flags, (Silurian Syst., pl. 25, fig. 2,) in which the serrations are, however, more pointed. Mr. Hall's specimen is from the Hudson River Group, Formation No. 3, of the Pennsylvania Report, a period far removed and earlier than Formation 11, in which this specimen was found, near to Pottsville. The serrated edge of *Ellipsocephalus Hoffii*, Zenker, in Burmeister's "Organization of *Trilobites*," (p. 74, pl. 1, fig. 8,) approximates very closely, in outline, to our figure.

In 1834, Mr. Taylor communicated to the Geological society of Pennsylvania that he had observed "at least two nondescript species of *Fucoides* in the *Old Red Sandstone* of Tioga county, Pennsylvania." (Transactions, vol. 1, p. 175.) And he subsequently observed obscure impressions of plants in the same formation, near to Pottsville, at Tumbling Run Dam. This obscure vegetation has been observed also by others, and there are now specimens in the collection of the Academy of Natural Sciences of this city.

The red sandstone rocks of this period present frequent and marked instances of cracks caused by dessication of the mud which opens into irregular fissures, which, on return of the tide, were probably filled up by sand, thus sometimes furnishing a tissue of meshes of various sizes, the interspaces being sometimes as great as three feet. A very remarkable one of this kind may be seen at Dauphin, near the Susquehanna, above Harrisburg, in this red sandstone, underlying the coal measures of that part of the same basin. The surface of the rock exposed there with these sun-dried sand-cracks, must be quite thirty feet, and some of the cracks were nearly a foot across.

1 Uncertain Organic remains
2 Probably Batrachian Ova

(EXTRACTED FROM THE TRANSACTIONS OF THE AMERICAN PHILOSOPHICAL SOCIETY.)

ARTICLE XXII.

Description of an extinct species of American Lion: FELIS ATROX. *By Joseph Leidy, M. D. Read May* 7, 1852.

Corresponding in some degree to the relative number in which Carnivora now exist, contrasted with Ungulata, remains of extinct species of the former are rare in their occurrence compared with the abundance in which similar remains of the latter are found.

Until recently no extinct representative of the genus Felis had been discovered in North America, but the especial subject of this communication indicates the former existence of a species which much surpassed in size the recent Tiger and Lion, or the extinct Felis spelæa of Europe.

The species is established upon the left portion of a lower jaw containing the three molars almost perfect, and the canine much broken (Pl. 34.) The osseous portion of the jaw is very friable, and has a thick envelope of compact peroxide of iron, from which the teeth protrude. Internal to the molars a layer of the latter substance stands up and is impressed upon its other face by a broad bone, which had been in contact.

The specimen belongs to this society, and when first observed was in company with several fragments of bones and a few teeth of other extinct mammalia, without labels, but from the condition of their preservation corresponding closely to that of some specimens, in several instances of the same animals, contained in the collection of the Academy of Natural Sciences, from ravines in the neighbourhood of Natchez, Mississippi, I have no doubt they were derived from the same locality, and probably constitute the donation entered upon the minutes of the Society, April 1st, 1836, of some fossil remains from the vicinity of Natchez, presented by William Henry Huntington, Esq.

Most of the mammalian remains found at Natchez are impregnated with oxide of iron, or are very friable, and enveloped in thick layers of this material very compact in character, or frequently in the case of the teeth have large nodules of the same substance attached, usually to the extremities.

The specimens in the collection of Mr. Huntington, accompanying the fragment of lower jaw, are as follow:—

1. A fragment of the lower jaw of the Mastodon.

2. Two isolated upper molars and an inferior last molar of a large species of Bison.

3. An upper and a lower molar of Equus Americanus, *Leidy*. The latter, with some small fragments of the lower jaw, adhere to a thick layer of oxide of iron impressed with the marks of three other molars.

4. Several fragments of bones more or less enveloped in oxide of iron, and not characteristic.

The collection of remains obtained by Dr. Dickeson at Natchez, preserved in the cabinet of the Academy, belong to the genera Megalonyx, Mylodon, Bison, Cervus, Equus, Mastodon, and Ursus.

From the associated remains found in this locality, the extinct species of Felis, indicated by the portion of lower jaw, which I propose to designate as the American Lion or Felis atrox, was cotemporary with the Mastodon, Megalonyx, Mylodon, Bison, Cervus, Equus, and Ursus.

The exact outline of the jaw in the specimen is difficult to ascertain, from its thick ferruginous coating, but from several exposed points of the body along its base it appears to have been a little convex downwards, as is frequently the case in the Lion. The symphysis rises in the gradual convex manner more usual in the latter than in the Tiger. The hiatus anterior to the molars is long, in correspondence with the size of the animal, but as in the Lion it rises relatively higher in its advance to the canine alveolus than is commonly the case in the Tiger.

No remains of the incisors exist in the fossil. The canine tooth is much mutilated; the summit and back part of the crown, and a layer from the fang being broken away. It appears originally to have been about six inches in length at its anterior convexity, and about fifteen lines in its antero-posterior diameter, and ten in its transverse diameter, at the enamel border of the crown. Its form also appears to have been closely what it is in the recent Lion and Tiger. Upon the inner side of the crown a portion of the characteristic longitudinal ridge exists, which is more prominent at its expanded base than in the animals last mentioned.

The crowns of the molars externally at their base are not so prominent as in the Lion, Tiger, and Felis spelæa, and appear in consequence more vertical and less convex.

The form of the carnassial tooth is very nearly the same as in all species of Felis. The obliquity of the cutting edges and the fissure separating them correspond pretty closely to the Tiger. The posterior lobe is one-fifth greater in its antero-posterior diameter than the anterior lobe, and it is strongly and evenly convex postero-externally. The point of the anterior lobe does not rise so abruptly or prominently as in the Tiger, or Felis spelæa, as represented in Cuvier's figure 7, plate 194, of the 4th edition of the Ossemens Fossiles, and its base externally presents a slight salient line or ridge.

The second molar tooth is relatively much greater in its antero-posterior diameter contrasted with its length, than in the Lion, Tiger, or Felis spelæa. The middle lobe of the crown is compressed conoidal, with a salient edge, and measures $6\frac{3}{4}$ lines at its base externally between the depressions separating it from the anterior and posterior tubercles.

The anterior tubercle is very much broader than in Felis spelæa, and resembles more in its form that of the Tiger; its salient edge being antero-posteriorly convex. The posterior tubercle rises very slightly higher than the anterior, and its antero-posteriorly convex margin descends to the outer side of the posterior heel of the tooth. The base of the crown presents a slight crescentic, roughened, salient line or ridge antero- and postero-externally.

The first molar also, as in the case of the tooth last described, is relatively greater in the antero-posterior diameter of the crown, compared with the length, than in the Tiger. The middle conoidal lobe slopes off gradually antero-externally to the base of the anterior prominent convexity of the crown, and its trenchant margin descends in a crescentic line forwards and inwards. The posterior tubercle is large and distinct, and its bottom postero-externally presents a quite salient basal ridge.

Admeasurements of the fragment of lower jaw of Felis atrox, in comparison with F. leo, F. tigris, and F. spelæa.

	F. leo.*	F. tigris.†	F. spelæa.‡	F. atrox.
Depth of lower jaw below the carnassial tooth, .	20	20	20	27 lines.
Depth below the first molar, ...	20	20	18	26 "
Length from the posterior part of the carnassial tooth to the front of the canine, ...	55	58	55§	77 "
Length of the molar series, ...	33	32½	38	41 "
Extent of hiatus anterior to the molars, . . .	13	14	13	20 "
Antero-posterior diameter of first molar, . . .	8¾	8½	8½	10 "
do do second do	12	12	13	15 "
do do third do	12	13½	14	15 "

*Measurements taken from a Lioness.

† Measurements taken from a very large specimen, from India, preserved in the Cabinet of the Academy of Natural Sciences.

‡ Cuvier: Ossemens Fossiles, ed. 4, t. 7, p. 452.

§ Ibid. Pl. 194, Fig. 7.

REFERENCES TO PLATE 31.

Figures the size of nature.

Fig. 1 represents the left side of the lower jaw of Felis atrox: the osseous portion entirely concealed by a thick envelope of oxide of iron, from which the teeth protrude.

Fig. 2.—Outer view of the canine tooth, removed from its socket.

(EXTRACTED FROM THE TRANSACTIONS OF THE AMERICAN PHILOSOPHICAL SOCIETY.)

ARTICLE XXIII.

A Memoir on the extinct Dicotylinæ of America. By Joseph Leidy, M. D. Read May 21, 1852.

The genus Dicotyles, so far as our knowledge extends, appears always to have replaced the genus Sus upon the American continent.

The two existing species of Dicotyles inhabit all the tropical parts of America, and even extend into Texas. The larger is the D. labiatus, the other the D. torquatus.

I have not been able to find any authority who gives the distinct osteological characters of the head of the two species except Dr. Rengger in his Naturgeschichte der Säugethiere von Paraguay, p. 329.

De Blainville in his Osteographie, Article Sus, has given three views, in Plate V., of the skull of D. labiatus, which he has named D. torquatus, although he has represented an undoubted entire skeleton of the latter in Plate III.

The differences observed between a specimen of the head of D. labiatus and five specimens of the head of D. torquatus, preserved in the collection of the Academy of Natural Sciences, are as follow:

The narrow portion of the cranium, produced by the approach above of the temporal fossæ, is not only relatively but absolutely longer in D. torquatus than in D. labiatus.

The lower portion of the face is relatively broader in the latter, produced by a prominence commencing on the inner side of the infra-orbitar foramen advancing and gradually increasing to the canine alveolus. The prominence slopes outwards from its upper part to its lower margin where it ceases abruptly, and overhangs the anterior premolar alveoli and the edge of the hiatus in advance of the latter, so as to conceal them in viewing the skull from above. It encroaches on the transverse diameter of the infra-orbitar foramen, and thus gives it a semi-oval form. It is hollow, and accommodates a large portion of the inferior scroll of the turbinated bone. In D. torquatus the prominence does not exist, and its position is occupied by a concavity proceeding from the infra-orbitar foramen, which in this species is oval. Moreover, the latter foramen in D. torquatus is above the third premolar, while in the other species it is above the first true molar.

The upper part of the face is broad, and relatively moderately convex, in D. labiatus, but narrow and strongly arched in D. torquatus. In the direction of the length of the ossa nasi in the latter it is slightly convex, but in the former in the same direction slightly concave.

The anterior free extremity of the nasal bones in D. labiatus is relatively long and subacute; short and convex in D. torquatus.

The external face of the malar bone below the orbit in the latter species is more depressed than in the other, and its infero-external margin forms an acute ridge, continuous upon the superior maxillary bone, shelving outwards from above, advancing obliquely over the infra-orbitar foramen, and disappearing in a slight prominence in a position corresponding to the bottom of the canine alveolus. The face, below this ridge to the alveolar margin, is concave. In D. labiatus the ridge of the maxillary bone, corresponding to the inferior margin of the malar bone, curves much more upwards than in D. torquatus, and ceases a very considerable distance posterior to its termination in the latter species. Beneath and within this ridge, the face is more deeply and vertically depressed than in D. torquatus.

The face, just in advance of the orbits, is less nearly vertical in the latter than in D. labiatus.

In the lower jaw the most striking difference between the two species is the strong bend inwards of the angle in D. torquatus, and its nearly vertical condition in D. labiatus.

Remains of extinct species of Dicotylinæ are frequent upon the American continent.

Lund first announced the existence of such remains in the Danske videnskab. Selskabs naturvid. Afhandl. volumes 8 and 9, for 1841–2. He observes they are often found in numerous caves of Brazil, and in the tables accompanying his memoirs enumerates five extinct species of Dicotyles, but does not describe the specimens upon which they are established.

In Bronn's Index Palæontologicus, part first, p. 422, is given the name Dicotyles major, *Lund*, as described by Clausen in the Neues Jahrbuch für Mineralogie, etc., 1843, but to this work I have not had access.

In the American Journal of Science for 1848,* Dr. J. L. Le Conte published an account of a collection of mammalian remains found in the lead region of Illinois. Most of the remains are referrible to Dycotylinæ, of which the author proposed three new species and genera: Platygonus compressus, Hyops depressifrons, and Protochœrus prismaticus. The former of these Dr. Le Conte afterwards described in detail in the Memoirs of the American Academy of Science and Arts for 1848.†

Subsequently, in the Proceedings of the Academy of Natural Sciences for 1852,‡ the fragments upon which was proposed Hyops depressifrons were referred to the genus Dicotyles, and a few additional remarks given upon Protochœrus prismaticus.§

* New series, vol. v. p. 102: Notice of five new species of Fossil Mammalia from Illinois.

† New series, vol. iii., p. 257: On Platygonus compressus: a new fossil Pachyderm.

‡ Vol. vi. p. 3. § Ibid. p. 5.

In the same work* Dr. Le Conte notices a fossil Dicotyles from Benton county, Missouri, found in association with bones of the Mastodon, for which the name Dicotyles costatus is proposed.

My friend Le Conte, with his usual liberality, has presented to the Academy of Natural Sciences the specimens upon which the species and genera just mentioned have been founded. Of these, I propose to examine in the succeeding pages only the more characteristic; not only for the purpose of determining as far as possible the distinct species and genera they indicate, which alone is a subject of greater importance to Palæontology than the unriddling to which animal every fragment belongs, but more particularly for the sake of comparison with an almost perfect head of an extinct animal, found in a saltpetre cave in Kentucky, belonging to the American Philosophical Society, and deposited by this body, in its desire to advance the interests of Science, in the Cabinet of the Academy of Natural Sciences.

The specimens of Dr. Le Conte's collection are very imperfect, brittle, and mutilated, and their investigation has by no means proved an easy one, nor have the results turned out so satisfactory as are desirable.

The most characteristic fossil, for which the name Platygonus without doubt must be retained, is the fragment of lower jaw presenting the peculiarity from which the animal derives its name.

The specimen consists of the hinder portion of the right half of the lower jaw of a middle-aged adult. It is much broken, and contains the two posterior molars, also broken, and fragments of the two in advance, (Pl. 38, Fig. 3.) Accompanying the specimen, and apparently belonging to the same individual, are the crowns of the posterior two true molars and premolars of the left side, and the last true molar and the inner lobes of the second, and the three premolars of the right side, of the upper jaw.

The fragment of lower jaw, (Pl. 38, Fig. 3,) is relatively deeper than in Dicotyles, and the angle is not only directed more downwards but it curves very much outwards. (Pl. 37, Fig. 9.) The condyle, broken at its inner side, has its articular surface a little more convex than in Dicotyles, and externally is not so prominent, and exhibits a small depression for the attachment of the external lateral ligament. The coronoid process is broken away. The fossa posterior to the latter process has the same form as in Dicotyles, but is relatively deeper.

The two teeth preserved in the specimen (Pl. 37, fig. 10,) are considerably worn, the dentine being exposed in lobate patches upon all the dental lobes, except the posterior and the internal of the middle pair of the last molar. These teeth are intermediate in size to those of the two existing species of Dicotyles, and are constructed on the same type, but their triturating surfaces have none of the wrinkled appearance existing in Dicotyles and reaching its excess in Sus, and the principal lobes are more prominently developed and relatively much longer, and the lesser or accessory lobes of Dicotyles disappear or exist only as continuous portions of the principal lobes. From trituration the principal lobes of the teeth in the fossil have become combined into transverse pyramidal

* Vol. vi p. 5.

ridges, separated by deep angular transverse valleys, causing the teeth to assume a remarkably taperoid appearance, and indicating a movement in the lower jaw of Platygonus, less rotary and more simply ginglymoid than exists in Dicotyles; for at the same stage of trituration of the teeth in the latter, the principal lobes would be worn down to a level with the bottom of the interlobular fissures, approaching more in this respect the Hog than the Tapir. In the last molar, the fifth or posterior lobe, broken in the specimen, is simple, and demiconoidal or flattened before and convex behind. Between it and the internal of the second pair of lobes, is a slight tubercle, a constituent portion of the basal ridge.

In neither teeth of the specimen do constituent portions of the basal ridge exist internally between the lobes, but externally, portions unite the bases of the latter.

The upper true molars (Pl. 37, fig. 13,) present the same striking peculiarities which distinguish them from Dicotyles, as the lower ones; that is to say, the principal lobes are very robust and prominent, the accessory lobes have disappeared, and the former and the basal ridge are unwrinkled.

These teeth are quadrate, constricted at the middle laterally, have convex sides, and are surrounded by a basal ridge open at the bases internally of the inner lobes. The latter are trilobate as in Hippopotamus, or expand before and behind, where they come in contact with the outer lobes, which are simply conoidal. In the specimens, the expansions just mentioned are worn away, leaving the transverse pairs of principal lobes associated as prominent pyramidal ridges, separated by deep and wide transverse valleys, as in the case of the corresponding teeth of the lower jaw.

The basal ridge is best developed anteriorly and posteriorly, and though worn smooth to some degree, yet appears never to have been so wrinkled or tuberculated and foveated as in the Peccary. In the last molar posteriorly, it is prominently convex, and at the middle rises in a simple short accessory tubercle associated with the postero-internal lobe.

The second and third premolars (Pl. 37, fig. 12,) are like one half of the true molars. They are quadrate, with rounded sides and angles, and narrowest and most convex internally, and have a single transverse pair of lobes like those of the true molars, surrounded by a cingulum open for a short space internally and externally at the bases of the corresponding lobes. The cingulum or basal ridge is nearly twice as thick posteriorly as anteriorly.

The crown of the first premolar (Pl. 37, fig. 12,) is trilateral, with rounded angles, and the apex forwards, and consists of a single conical lobe, surrounded at its inner four-fifths by a strong basal ridge best developed posteriorly.

Found in the same crevice with the specimens just described, was a fragment of the face of a young animal containing upon the left side the three permanent premolars, which had not yet protruded, the fangs of the canines, and a single lateral incisor. (Pl. 38, fig. 2.) This specimen Dr. Le Conte referred to Platygonus compressus in his memoir on the latter, but subsequently, from comparison with the cave head alluded to, was led to suspect it belonged to Dicotyles depressifrons.* From more prolonged compa-

* Pr. Acad. Nat. Sci., vi. 57

rison, however, I am inclined to believe Dr. Le Conte was right in referring it to Platygonus compressus, for the form of the fragment of face is very different from the corresponding portion of that specimen upon which Dicotyles depressifrons was characterized. And further, the premolars contained in the fragment (Pl. 37, fig. 11,) have the same form and size as those just described, (Pl. 37, fig. 12,) which with very little doubt belonged to the same individual as the fragment of lower jaw characteristic of Platygonus. In both, the first premolar possesses but a single conical lobe, which is a very different condition of the tooth as it exists in Dicotyles, or the cave head hereafter to be described.

The fragment of a face under consideration, which most probably belongs to Platygonus compressus, is constituted by portions of the superior maxillary bones, the right intermaxillary bone and a portion of the right nasal bone. It appears narrower or more compressed laterally than in Dicotyles torquatus, arising principally from the absence of the ridge so conspicuous in the latter proceeding from the inferior margin of the malar bone.

The nasal bone is a little less convex transversely than in Dicotyles torquatus, but is about as much so longitudinally.

The crescentic ridge of the canine alveolus rises higher relatively than in Dicotyles, and in its course forwards runs into the margin of the nares. The intermaxillary bone appears to be unusually long, its upper end being over three inches posterior to the summit of the canine alveolar ridge. Its lateral surface at the upper extremity presents directly outwards, but at the lower half inclines at an angle of about 50°. The upper part of the superior maxillary bone about three inches posterior to the canine alveolar ridge, is protuberant, but presents no indication of possessing the acute ridge proceeding from the malar bone and characteristic of Dicotyles. The permanent premolars (Pl. 37, fig. 11,) preserved in the specimen from being unworn, exhibit better their characters in detail than those described. As before mentioned, they have the same size and form of those just alluded to. Their basal ridge is tuberculate and foveate. The principal lobes in the hinder two premolars are confluent at the middle of their basal two-thirds.

The hiatus between the first premolar and the canines, is about one and three quarter inches. The canines have about the same degree of divergence from each other as in Dicotyles, but they appear to project a little more forward.

A detached upper canine tooth (Pl. 37, fig. 16,) undoubtedly belonging to the same species, and having the crown perfect and but little worn, exhibits the same form, and about the same degree of lateral compression as in Dicotyles torquatus.

The hiatus between the anterior margin of the canine and the lateral incisor is about ten lines.

The latter tooth in the specimen is one of the permanent incisors, and it had not yet entirely protruded. Its crown is but little more than half the size of that of D. torquatus, and its form is more simple; being short and slightly compressed mammillary, with the apex impressed by an O shaped disk, with a slightly prominent tubercle in its centre. It is convex both anteriorly and posteriorly; in the latter position, being concave in Dicotyles.

In Dr. Le Conte's collection there is a second premolar, (Pl. 37, fig. 14,) and the first and second true molars, (fig. 15,) of the superior left side, which have been referred to Dicotyles depressifrons,* but which correspond so closely in size and form with the teeth described of Platygonus, that I think they belonged to another and younger individual only of the latter.

ADMEASUREMENTS OF PLATYGONUS.

Fragment of Lower Jaw.

Height from angle to condyle,	3 inches 9 lines.
do of body below last molar,	1 " 11 "
Ant. post. diameter of last molar,	" 10 "
Transverse do do	" $5\frac{3}{4}$ "
Ant. post. diameter of second true molar,	" $7\frac{1}{2}$ "
Transverse, do do do	" $5\frac{1}{4}$ "

Isolated Upper Molars.

Length of premolar series,	1 inch 2 lines.	
	Ant. post.	Trans.
Diameter, first premolar,	$4\frac{1}{2}$ lines.	$3\frac{3}{4}$ lines.
do second do	$4\frac{1}{2}$ "	5 "
do third do	5 "	$5\frac{3}{4}$ "
do first true molar,	6 "	$5\frac{3}{4}$ "
do second do	$7\frac{1}{2}$ "	$6\frac{3}{4}$ "
do third do	9 "	$7\frac{1}{2}$ "

Fragment of Face.

Height of crescentic ridge of canine alveolus,	1 inch 3 lines.
Distance from summit of the latter ridge to the upper end of the intermaxillary bone,	3 " 4 "
Narrowest part of face below the upper extremities of the intermaxillaries,	1 " 2 "
Breadth of each os nasi about middle,	6 "
Height of face about one inch in advance of the molars,	2 " 2 "
Length of line of permanent premolars,	1 " 1 "
Transverse diameter of first premolar,	4 "
Ant. post. do second do	$4\frac{1}{2}$ "
Transverse, do do do	5 "
Ant. post. do third do	$4\frac{3}{4}$ "
Transverse do do do	$5\frac{3}{4}$ "

Isolated Superior Canine.

Length of enamelled crown internally,	1 inch, 7 lines.
Antero-posterior diameter at base,	6 "
Transverse do do	$3\frac{1}{2}$ "

Other fragments, probably belonging to Platygonus compressus, and presented to the Academy by Dr. Le Conte. These are as follow:—

1. Fragments of the forehead, (Mem. Am. Acad. Arts and Sci., vol. 3, plate 2, fig. 4,) indicating the breadth at the post orbital processes to be three and a quarter inches.
2. Several fragments of an os malæ and hard palate.
3. Bodies of a dorsal and lumbar vertebra, (Ib., plate 3, fig. 14; plate 4, figs. 16–18.)
4. Portion of os innominatum.

* Pr. A. N. S., vi. 3.

5. Lower part of both ossa humeri (Ib., plate 4, fig. 21,) of the right side.
6. Bone of fore arm, (Ib., plate 4, fig. 21.)
7. A right metacarpal, without the distal epiphysis, (Ib., figs. 23, 24.)
8. Two astragali: diameter from the bottom of the tibial to the distal trochlea fourteen lines; transverse diameter at middle eight lines.
9. Fragment of an os calcis.

The most important specimen, upon which the genus Hyops was proposed, consists of the upper portion of a cranium and face much fractured, (Pl. 38, Fig. 1). The size of the fragment is such as to indicate the existence of an animal a little larger than the Dicotyles labiatus, but possessing relatively a little shorter and broader forehead, and a longer and broader, but shallower face. The lateral margins of the forehead and the upper part of the inion are broken away, but it appears as if the length of the former had a little exceeded its breadth. The forehead is also a little more depressed on each side.

The face slopes from the position of the orbito-frontal foramina more abruptly downwards and forwards than in Dicotyles, and after two inches of its course rather abruptly ceases to incline so much downwards. That portion of the ossa nasi posteriorly and outside of the groove leading from the orbito-frontal foramina is prominently convex, and on a level with their median line. The fronto-nasal suture forms the outline of a depressed cone with rounded apex, two and a half inches wide at base, and thirteen lines in depth. Anteriorly the ossa nasi are about as convex transversely as in D. labiatus.

The orbito-frontal foramina are thirteen lines apart. The upper extremity of the ossa inter-maxillaria, alone preserved in the specimen, inclines at an angle only of about 35°, and the distance of its point from the suture connecting the nasal process of the superior maxillary bone with the os frontis, is two inches one and a half lines. The nasal process of the superior maxillary bone slopes from the ossa nasi laterally at an angle of about 35°.

A prominent acute ridge appears to have existed at the side of the superior maxillary bones, proceeding forwards from the inferior margin of the malar bone in the existing species of Dicotyles, and more especially like that in D. labiatus, but the specimen is too much mutilated to determine its exact extent and character.

The anterior extremity of the malar bone is broad, not more depressed than in D. labiatus, and inclines at about the same angle as the contiguous portion of the superior maxillary bone.

The fractured condition of the specimen permits the extensive sinuses to be seen which every where occupy a position between the tables of the cranial bones, and communicate freely with the ethmoidal and nasal sinuses.

From what has been stated in regard to this fragment, it will have been perceived not to possess a single character which would separate the animal from the genus Dicotyles, to which Dr. Le Conte considered it belonging, subsequently* to its being first ascribed to Hyops.

* Pr. A. N. S., vi. 3.

Admeasurements of the Fragment of Cranium of Dicotyles depressifrons.

Length of os frontis,	2 inches,	9 lines.
Estimated length from inion to ossa nasi,	4 "	6 "
Distance between orbito-frontal foramina,	1 "	1 "
Breadth of ossa nasi at angular processes of os frontis,	2 "	2 "
Breadth of ossa nasi at upper end of intermaxillaries,	1 "	4½ "
Distance from latter to angular processes of os frontis,	2 "	2 "

In company with the fragment of cranium just described as expressive of Dicotyles depressifrons, there also was found a fragment of the left side of the lower jaw containing a portion of the corresponding canine tooth, and the distal extremity of a left canine possibly belonging to the same individual as the former.

The specimens indicate a larger species than those recent, and both belonged to an old individual.

The fragment of jaw along the course of the canine alveolus externally is very convex, and just posterior to the symphysis is ten lines thick, and from the base to the edge of the hiatus, a little posterior to the position of the mental foramen, measures fifteen and a half lines. The portion of the fang of the canine remaining in the alveolus at its broken extremity has the dental cavity nearly obliterated. In transverse section the fang of the tooth is quadrilateral, with its longest diameter antero-posterior; anteriorly it is narrowest and convex; externally it presents a projecting longitudinal ridge; posteriorly a longitudinal groove; and internally is convex posteriorly but longitudinally depressed anteriorly.

The distal fragment of tooth presents the same relative proportions and form as the fragment of fang retained in the alveolus. It of course becomes in section trilateral, as in existing species of Dicotyles. The end only, of the specimen, which in curve is two and three quarter inches long, has enamel upon it: internally for about one inch, externally for ten lines, and the body of the tooth, with the exception of a remaining portion of the pulp cavity about one-third of a line in diameter, is a solid rod of dentine. The greatest antero-posterior measurement of the fang is eight lines, and that transverse six lines.

Other fragments probably belonging to Dicotyles depressifrons.

Some other specimens presented by Dr. Le Conte to the Academy, which may be considered as belonging to Dicotyles depressifrons, are as follow:

1. Distal extremity of both ossa humeri: slightly more robust than in Platygonus.

2. Left os femoris, like that of Dicotyles torquatus, but larger; its length being seven inches and its circumference at the middle of the shaft two inches and a quarter.

Besides these, there are fragments of the second right metacarpal, left os innominatum, and left tibia, also a scaphoid and cuboid,* and two first phalanges and one second phalanx.

The specimens upon which Dr. Le Conte proposed the Protochœrus prismaticus† consist of an inferior canine, and a first true and a portion of a last molar of the right side, most

* Mem. Am. Acad. Arts and Sciences, vol. 3, pl. iv. fig. 25, 26.

† Am. Journ. Sci., 2d series, vol. V., p. 105; Proc. Acad. Nat. Sci., vol. VI. p. 5.

probably of that above. They were found under circumstances similar to those already described, but in another locality fifteen miles distant.

The three teeth probably belonged to the same individual, which had passed the middle of adult life, as the specimen of the first true molar, which is about the size of that of the collared Peccary, has its characteristic triturating surface nearly obliterated.

The most characteristic specimen is the fragment of the last molar (Pl. 37, fig. 18), which in outline resembles more the lower than the corresponding upper tooth of the Peccary, but its proper position has been rather determined by comparison with the teeth in the cave head. In the robustness of its lobes it approaches more that of Platygonus than that of the Peccary, and from their prominent prismoid character the specific name which has been applied to the animal is quite appropriate. Its admeasurements are as follow:

Estimated antero-posterior diameter, - - - - - 10 lines.

Breadth at middle, - - - - - - - - - 6 "

The first true molar measures six lines antero-posteriorly, and four and three quarter lines in breadth.

The inferior canine was rather smaller than that of the cave head, and it evidently belonged to an old individual, as the enamelled portion of the crown is worn away to a length of about sixteen lines, while the remaining portion of the fang, about ten lines long, is somewhat gibbous, and is solid, except a pulp canal in the centre about half a line in diameter. In section the fang is oval, but impressed posteriorly. The external and internal faces of the crown are smooth and convex.

It is not possible at present to determine whether the teeth ascribed to Protochœrus do not belong to the same animal characterized from a cranial fragment under the name of Dicotyles depressifrons. If they should be proved hereafter to do so, then both the teeth and cranial fragment must fall back into the genus Hyops, previously proposed to Protochœrus, for the posterior molar tooth described of the latter evidently is generically distinct from that of the recent Dicotyles.

Dicotyles costatus was established by Dr. Le Conte from a fragment of the symphysis of the lower jaw in connexion with the right inferior canine tooth. The specimen was found in Benton county, Missouri, in association with bones of the Mastodon. The tooth is larger than that of Dicotyles labiatus, and the anterior margin of the crown is more acute than in any of the specimens of recent Dicotyles which have come under my notice. Its inner side is smooth and convex, and its outer side presents a prominent longitudinal ridge, from which the species is named, but which is sometimes even better developed in the Dicotyles torquatus.

The specimen probably indicates a species larger than either of those existing.

Admeasurements.

Greatest breadth at the base of the enamelled crown of the inferior canine, $5\frac{3}{4}$ lines.

Antero-posterior diameter, - - - - - - 7 "

On the occasion of the removal of the collection of Mammalian Remains deposited by the American Philosophical Society, in the cabinet of the Academy of Natural Sciences,

I observed an apparently recent skull labelled "Peccary, presented by Dr. Samuel Brown, December, 1805." It struck me as being unusually large, which led me to compare it with the heads of the Dicotyles torquatus, and D. labiatus, when it proved without doubt to be very distinct from either. But how the head of a third species of existing Peccary should be preserved in the cabinet of our Society for forty-seven years, and the animal be entirely unknown, puzzled me. On examining the minutes of the society for 1805, to find out the locality from whence the specimen was obtained, the mystery was solved. At a meeting of the Philosophical Society, December 20th, 1805, "The bones of the head of a new animal, found in a saltpetre cave, and a specimen of pure native saltpetre, were presented by Dr. Brown of Kentucky." In the course of the same meeting the head was referred to Dr. Wistar for examination, who, at the meeting of January 7th, 1806, reported that the head of what was supposed to be a new animal, presented by Dr. Brown, proved to belong to the Peccary of South America, as described by Daubenton in Buffon's work.

Dr. Harlan refers to this skull in a foot note to page 222 of his Fauna Americana, and observes it "certainly belonged to the recent *Peccari*."

The remarkable condition in which the specimen has been preserved no doubt favoured the impression of those who examined it, that it belonged to the recent Peccary. The texture remains entirely unchanged, and it looks as fresh as if prepared but a few years ago, and had become ochreous yellow from being kept out of the influence of light. Within the open fangs of several of the molars I noticed a few small pieces of adhering adipocire. Its state of preservation, however, is not so remarkable as in the case of the bones of the Megalonyx laqueatus, *Harlan*, contained in the Cabinet of the Academy of Natural Sciences, and found under similar circumstances: namely, in a cave in Tennessee. These bones not only retain their original texture, but also have attached shreds of fibrous tissue, portions of articular cartilage, and upon one os unguis nearly the entire nail.

With the exception of the greater portion of the ossa nasi, one upper canine, and all the incisors but one inferior lateral, the cave head under consideration is almost perfect, (Pl. 35, 36.)

The animal to which it belonged had not yet reached adult age, although many of the sutures of the skull are nearly obliterated. The summits only of the anterior lobes of the last molars of both jaws have just protruded, and the deciduous molars had not been shed. The latter are preserved on the left side of the upper jaw, but all those of the lower jaw, and of the right side above, except one, are lost.

The general form of the cave head is most like that of the recent Peccary, but differs strikingly in the great relative breadth of the forehead and the more abrupt narrowing and greater degree of prolongation of the face.

The upper part of the occiput in the fossil is relatively broader and shorter than in the Peccary, and the lateral margins, instead of being nearly parallel, as in the latter, form with the summit a semicircle. The infero-lateral portions of the occiput on the same plane with the mastoid portions of the ossa tempora present more outwardly or are more bent forwards. The occipital foramen has the same form as in the Peccary, but the superior margin projects more posteriorly. The condyles have the same relation to the foramen, and the para-mastoid processes the same form and direction.

The top of the cranium or forehead, considered as extending from the inion to the root of the nose, is broader at the post-orbitar processes than it is long, but in the Peccary the length greatly exceeds the breadth. It is also more convex antero-posteriorly, but much less so transversely, being nearly flat.

The orbito-frontal foramina and the vasculo-neural grooves leading from them to the side of the face, hold the same position as in the Peccary. From the depression of the forehead the orbit appears more elevated than in the latter: the lachrymal tubercle being only eight lines below the level of the forehead in the fossil, while it is one inch below it in D. torquatus.

The temporal fossa has the same form as in the latter, but its surface extends more outwardly in the direction of the post-orbitar processes. Its length is absolutely not greater than in D. torquatus, but it gains in depth and extent by the increased depth of the zygomatic process.

The malar bone is of extraordinary depth, relatively very much more than in the Peccary. Its outer side is not depressed, as in the latter, but is antero-posteriorly convex, and the inferior margin rises much more upwardly. The masseteric surface of origin, instead of being directed downwards, as in the Peccary, presents more outwards, as in the Hippopotamus, and the acute margin bounding it externally ceases at the maxillary suture, while in the Peccary it is continuous with a highly characteristic prominent, acute ridge of the maxillary bone, advancing anterior to the position of the infra-orbitar foramen. The maxillary bone in the fossil, immediately in advance of its conjunction with the malar bone, is elevated into a protuberance upon the same level as the outer surface of the malar bone. The latter rises much higher upon the face than in the Peccary, reducing the nasal process of the superior maxillary bone into a relatively narrow strip, and aiding in the elevation of the orbit anteriorly.

The transverse diameter of the orbit is greater than the vertical and its direction obliquely upwards and forwards, but in the Peccary the former is the shorter diameter and its direction downward and forward.

The face, anterior to the temporal fossa, is relatively very long, compared to that of the Peccary. It is also relatively narrower, principally from the absence of the ridge of the maxillary bone continuous with the malar bone in the latter, which also renders it nearly vertical from the edges of the ossa nasi at its anterior two-thirds.

The central part of the sides of the face, over the position of the infra-orbitar foramen, is concave, and is most deeply so just anterior to the latter foramen, which is oval in its form and situated above the interval of the third and fourth molars. The alveoli have a more advanced position in the face than in the Peccary, in which the last molar is on a line with the ant-orbital margin, but in the fossil is placed an inch anterior to it.

The upper part of the face, as constituted by the ossa nasi, is for the most part broken away in the fossil. Its posterior part is broad and only a little convex transversely, while its anterior three-fourths, judging from a small remaining fragment, appears to have been as convex as in D. torquatus.

The anterior extremity of the face is more pointed than in the Peccary from the ad-

vancement of the intermaxillaries several lines beyond the alveoli of the central incisors, indicating probably a more prolonged upper lip than in the animal just mentioned.

The basilar process, instead of being nearly horizontal and plane, as in the Peccary, ascends obliquely, is carinated inferiorly, and terminates on each side anteriorly in a relatively very large, prominent tuberosity, serving as an abutment for the post sphenoidal body. Just in advance of the condyles it is depressed on each side into a deep pit for muscular insertion. The ossa tympanica have the same form and construction as in the Peccary. The guttural region exhibits some of the most remarkable features of the cave head.

The post-sphenoidal body in the Peccary ascends at a very obtuse angle from the basilar process, but in the fossil ascends vertically from the line of the palate, and curves forward continuous in the latter direction with the ant-sphenoidal body. The surface of the post-sphenoidal body presents directly forward, and is concave on each side; and that of the ant-sphenoidal body is directed downwards, and is deeply concave upon each side of the azygous process. Compared to the Peccary, a relatively very deep and capacious fossa with concave sides exists in the fossil between the posterior nares and the post-sphenoidal body. It is divided antero-posteriorly by the middle prominence of the latter and the azygous process of the ant-sphenoidal body. Its sides are constituted by the anterior portion of the roots of the external pterygoid processes dilated or bulging outwardly, in conjunction with a lateral expansion of the ant-sphenoidal body where it descends to form the internal pterygoid process. The communication below is trilobate; the corresponding position in the Peccary being cordiform.

The ossa palati early unite with the superior maxillary bones as in the Peccary, so that the transverse palate suture is no more visible. In the Peccary the palate bones where they unite rise posteriorly in the form of a deep angular groove to the inferior edge of the nares, but in the fossil their palate plates are transversely concave, and form between the extremities of the internal pterygoid processes a sharp crescentic edge, between which and the inferior margin of the nares is a remarkable cul-de-sac, divided into two unequal portions by a vertical partition on the left side of the median line. The space in which this cul-de-sac is situated is eleven lines high from the palatal to the naral margin, and the bottom of the sac extends about one-fourth of an inch anterior to the palatal margin

An enormous cellular dilatation of an oval form apparently protrudes from between the maxillary and palate bones, and extends backwards to the anterior margin of the external pterygoid process. Its interior communicates anteriorly with the cavity of the nose; externally it is convex, and on its inner surface, forming the lateral parietes of the posterior nares, is concave. It is about two inches long, and at the middle about an inch deep, and three-fourths of an inch wide. It appears to be formed by the palate bone, but of this I am not sure, as its sutural connexions are for the most part obliterated. A similar but smaller dilatation exists in Dicotyles labiatus, but in the specimen I have under comparison its sutural connexions are also entirely obliterated.

One of the most remarkable characters of the cave head is the excessive cellular dilatation of the bones about the middle of the face. In addition to the larger dilatations just

described, between the posterior nares and temporo-maxillary fossæ, the malar bones are very much dilated and cellular; the cells communicating with the interior of the maxillary bones. The latter also are not only very much dilated in advance of the malar bones, but between these and the palate bones above the alveoli they extend backward in a cellular cavity, closed behind by the os unguis, at least an inch from the last molar tooth.

The foramina at the base of the cranium have the same arrangement and relations as in the Peccary.

The glenoid cavity is a little more antero-posterior in its long diameter than in the latter, and instead of being upon a level at bottom with the os tympanica is removed from it obliquely downwards and forwards for nearly an inch by the unusual prolongation in this direction of the zygoma.

The meatus auditorius externus is placed in the same relative position as in the Peccary, and is the extraordinary distance of two and a half inches from the glenoid articulation.

The hiatus anterior to the molars is relatively longer than in the Peccary. Its margin is rounded, and out of it rises a linear ridge proceeding to the back of the canine alveolus. Above it, the face exhibits an obtuse low ridge proceeding from just below the infra-orbitar foramen forward, and expanding the whole length of the crescentic ridge of the canine alveolus, so conspicuous a character in the Peccary. The latter ridge at its upper part turns inwards and forwards to the antero-lateral edge of the nares as formed by the intermaxillaries and expands gradually downwards and vanishes upon the incisive alveoli. The notch included by the canine alveolar ridge for the reception of the crown of the lower canine when the jaws are closed, is about one and a fourth inches high, and as wide at bottom as the hiatus between the canine and lateral incisor.

The infra-orbital canal commences immediately above the last molar alveolus. The supra-palatine foramen, as it should be called, instead of spheno-palatine, because the sphenoid bone does not always enter into its composition, is placed above and to the inside of the former, is bounded above by the large cellular dilatation of the posterior nares, and is continuous upwards and outwards with the fissure between the latter and the superior maxillary and lachrymal bones. The posterior palatine canal commences at the bottom of a vertical fissure passing from the last designated foramen downwards between the vertical plate of the palate bone and the tuberosity produced by the last molar alveolus. Its exit upon the surface of the hard palate is near the middle of the hiatus anterior to the molars, a couple of lines within its margin, and is continuous with a groove advancing to the naso-palatine foramina, as in the Peccary.

The relative position of the molars, canines, and incisors, is the same as in the latter.

The true molars of the recent Peccary (Pl. 37, figs. 1–4,) appear to be constructed on the type of the Hog, whereas in the cave head they partake more of the character of the Hippopotamus. In the former the crowns present two pairs of principal, short, conoidal, wrinkled tubercles, with constituent portions of the basal ridge wrinkled and tuberculate. The last lower molar, as in all Pachyderms, has its additional lobe. In the latter the principal lobes are relatively very long, prismoid, not wrinkled, but constricted at the sides, and opposed to one another as in the Hippopotamus, so that when the summits are worn off,

they present a slight trefoil appearance. The basal ridge, where it exists, is more foveate, less wrinkled, and more prominently tuberculate. Indeed, the true molars of the Peccary have the appearance as if they had been cast of some soft substance, in the same mould as those of the cave head, and had become contracted in bulk and wrinkled in drying.

The three superior true molars (Pl. 37, figs. 5, 6,) of the cave head decrease in size from the last to the first; the external lobes are smaller than the internal, and a broad basal ridge surrounds them, open only at the bases internally of the inner lobes, and external part of the base of the antero-external lobe of the last tooth. In the latter, the posterior pair of lobes is shorter than the anterior, and that postero-external is the shortest lobe of those of any of the teeth.

The external lobes are simply conoidal; the inner ones are shaped like those of Hippopotamus, or expand anteriorly and posteriorly where they come in contact with the former. In the Peccary and Hog, these expansions are more or less isolated, appearing as accessory wrinkled tubercles. In the cave head the posterior expansion or fold of the antero-internal lobe comes in contact at its lower part with the anterior of the postero-internal lobe, and thus divides the transverse interlobular fissure. The anterior fold of the former lobe and the posterior of the latter divide the basal ridge anteriorly and posteriorly, and are confluent with it.

The basal ridge of the superior true molars anteriorly, is thick, delicately folded, and finely denticulate at the free margin. Posteriorly it has nearly the same appearance, except in the last tooth, where it is much thicker, includes two small foveæ with wrinkled sides, and is divided by a fissure into two unequal tuberculoid portions. Externally in the last tooth the ridge is continuous round the base of the postero-external lobe to the posterior part of the lobe anterior, is thick, folded, and crenulate at margin, and between the lobes includes a fovea containing several minute tubercles. On the other two molars externally the basal ridge is thinnest, and between the lobes includes a fovea with wrinkled sides. Internally in all the upper true molars, constituent folded portions of the basal ridge connect the bases of the inner lobes and enclose foveæ with wrinkled sides.

The inferior true molars (Pl. 37, figs. 7, 8,) have a greater antero-posterior diameter than those corresponding above, but are narrower, and their lobes, also in pairs, are more nearly equal and longer. Constituent portions of the basal ridge exist anteriorly, posteriorly, and between the bases of the lobes externally and internally, where it is, however, relatively feebly developed compared with its condition in the upper molars. The teeth also decrease in size from the last to the first. The lobes are elongated, conoidal, those internal sending a fold backward where they come in contact with the external lobes, and the latter sending a like fold forwards. The anterior fold of the postero-external lobe joins the posterior of the antero-internal lobe. The posterior fold of the postero-internal lobe is relatively very slight to the others.

The basal ridge posteriorly rises into a prominent pyramidal tubercle, most so in the last, where it constitutes the fifth lobe, and least in the first true molar. Between this tubercle and the posterior pair of principal lobes in the last molar, a second and smaller compressed tubercle exists. Anteriorly, the basal ridge is nearly horizontal and denticu-

late. Between the lobes externally it forms a small simple tubercle. Internally, in the same position, it is hardly developed, except in the last molar, where it is also a simple tubercle. In the latter tooth posteriorly on each side of the fifth lobe, it is constituted by a simple tubercle.

The superior deciduous molars preserved in the cave head, (Pl. 37, fig. 17,) regularly decrease in size from the permanent true molars to the first of the former. The third and second superior deciduous molars closely resemble the permanent teeth behind, except that the anterior part of the crown of the second is narrower. The first deciduous molar possesses but a single transverse pair of tubercles, and its crown is trilateral.

From the trituration to which the deciduous teeth have been subjected, trefoil-like tracts of dentine are exposed upon the inner lobes, and simple transverse oval ones upon the summits of the outer lobes. Judging from the wearing of these teeth, the relative length of the lobes of the permanent molars, and the depth of their intervening valleys, the movements of the lower jaw in the animal to which the cave head belonged, were rather more restricted ginglymoid in their character than in Dicotyles, but perhaps in a less degree than in Platygonus.

In the Peccary the superior premolars (Pl. 37, figs. 1, 2,) still present the same general construction as the true molars. The posterior two present very distinctly the four characteristic wrinkled conoidal lobes, but the postero-internal is reduced in size in the third premolar, and is very feebly developed in the second. The crown of the first is trilateral, and still presents four distinct tubercles, but only one is strikingly prominent.

In the cave head, the three superior permanent premolars, (Pl. 37, figs. 5, 6,) present each a transverse pair of permanent lobes like those of the true molars, surrounded by a basal ridge. The latter anteriorly and posteriorly is very thick and denticulate at the margin. In the posterior two premolars the hinder portion encloses four small irregular foveæ with wrinkled sides, the anterior portion two similar but larger foveæ. In the first premolar the basal ridge forms a cup with wrinkled sides, from the bottom of which project the two characteristic lobes.

The inferior premolars (Pl. 37, figs. 7, 8,) of the cave head resemble those of the D. torquatus (Pl. 37, figs. 3, 4,) with the principal lobes much exaggerated. They decrease successively anteriorly, and are much more nearly equilaterally quadrate than in the Peccary. The posterior two premolars of the fossil are more like the second than the third of the Peccary, but are relatively broader. Each has a transverse pair of principal lobes, very long and shaped like those of the true molars, and bounded behind by a very thick basal ridge rising in an antero-posterior prominence at the middle, and enclosing on each side of the latter a large fovea with wrinkled sides. Anteriorly, also, the basal ridge exists, but is feeble, whether contrasted with the posterior portion or that corresponding to it in the D. torquatus. The first premolar is square, or relatively very broad contrasted with that of the Peccary, and the basal ridge forms a cup with wrinkled sides, out of the bottom of which rises a transverse pair of short conoidal lobes.

In Dicotyles the exserted portion of the upper unworn canine is enveloped in enamel, ceasing by a sinuous margin at its base and deeply notched anteriorly. The inferior

canines, also, when unworn, are enveloped in enamel, even deeply into the alveoli, except on the posterior concave surface, where a long angular notch extends upwards into the enamel covering. As the animal advances in life, a little after adult age the enamel is completely worn off from the posterior face of the latter tooth, and at a later period the enamelled portion of the tooth becomes completely exserted from the alveolus, the permanently growing dentinal portion alone occupying the latter.

In the cave head we have been particularly engaged in examining, the canine teeth do not differ in construction from those of the existing Dicotyles, and their form also is very nearly the same. They are a very little larger than those of D. torquatus. The superior canine is compressed to about the same degree as in the former, but it is a little narrower, more convex externally, and to a trifling extent less so internally. The lower canine is relatively more exserted than in either existing species of Dicotyles, is convex and smooth internally and externally, and exhibits only a slight disposition to the formation of a ridge at the lower part of the enamelled crown externally.

As before stated, the incisors are not preserved in the cave head, except one (Pl. 37, fig. 19) of those inferior and lateral. This is smaller than in D. torquatus, is enclosed within the alveolus, and appears as if it would have always remained concealed. Its crown is simply mammillary, very slightly compressed antero-internally.

Having described this interesting specimen in comparison with the two existing species of Dicotyles, we have next to ascertain whether it differs from any of those Dicotylinæ whose former existence has been established by Dr. Le Conte.

From the fragment of lower jaw of Platygonus compressus the corresponding portion of the cave head differs in its being relatively less deep, and in its angle not being produced so much downwards, and instead of curving outwards, as is so remarkably the case in Platygonus, it is nearly vertical. The post-coronoid depression is also considerably less deep. The posterior two molars are a little larger than those remaining in the specimen of Platygonus, and in the last molar a large accessory lobe is introduced between the fifth and middle pair of lobes, no trace of which exists in the latter.

A good deal of similarity exists between the fragment of the face of Platygonus and the corresponding portion of the cave head. In both they present about the same degree of lateral compression; the acute ridge of the superior maxillary bone proceeding from the malar bone, as in Dicotyles, is absent; the crescentic ridge of the canine alveolus has about the same extent and course; and in the same relative position in advance of the malar bone superiorly the upper maxillary bone is protuberant. But in the cave head the face is relatively longer, while its intermaxillaries are broader and very much shorter, being $2\frac{1}{4}$ inches in length from the lateral notch of the nares, while in Platygonus they are one inch longer.

The posterior two premolars have nearly the same form, but the basal ridge is less strong in Platygonus, and is not so deeply foveated. The first premolar in the cave head is quadrate, and has two prominent principal lobes like the two posterior premolars, and possesses a strong basal cingulum open for a short space only internally. In Platygonus

the first premolar is trilateral, with one principal lobe, and has its basal ridge open externally. The last superior true molar of the cave head is trilateral, with its rounded apex posterior, while in Platygonus it is broader, quadrate, has its constituent portions of the basal ridge laterally less developed, and has its postero-external lobe better developed.

Having said enough to prove the cave head is not only specifically but generically distinct from Platygonus compressus, we have next to compare it with the specimens referred to Dicotyles depressifrons. With this purpose in view, the first thing which strikes us in examining the fragment of skull of the latter is the evident existence of the acute ridge on the side of the superior maxillary bone, proceeding from the inferior margin of the malar bone, as in recent species of Dicotyles, but which does not exist in the cave head.

In the fragment of the skull of Dicotyles depressifrons, as before stated, the forehead appears to have been longer than broad, as in recent species of the genus, but in the cave head the breadth greatly exceeds the length.

The face is very much broader in Dicotyles depressifrons than in the latter, and has probably been shorter, for in the fragment the distance from the upper end of the intermaxillaries to the suture of the nasal process of the superior maxillary bones with the frontal is a little over two inches, while in the cave head from the same points the distance is one and a quarter inches greater.

In Dicotyles depressifrons the nasal process of the upper maxillary bone is broader and more rapidly divergent anteriorly than in the cave head. The upper extremity of the intermaxillaries in the former incline 35°, while in the latter it is nearly vertical, and the face behind these bones, still sloping in the Dicotyles depressifrons to the margin of the maxillo-malar ridge, is vertical in the cave head until it begins to dilate posteriorly.

Other but more trifling differences exist, but it is evident, from the comparison which has been made, that the cave head, without doubt distinct from Dicotyles, also evidently could not have belonged to the same animal characterized by the cranial fragment as Dicotyles depressifrons.

The only specimen among those referred to Protochœrus prismaticus sufficiently characteristic for comparison with the cave head is the fragment of a last upper molar. The first upper true molar of the cave head has about the same size, and if worn down to the same extent would probably have the same appearance as that ascribed to Protochœrus, which, however, would also be the case with the much worn tooth of Dicotyles. The lower canine also of the cave head, if much worn down, would present about the same size and proportions as that of Protochœrus, and this also would be the case with that of the collared Peccary under the same circumstances.

The last upper molar of the cave head is in a trifling degree broader than that of Protochœrus, and the postero-external lobe is relatively to the others less developed. The basal ridge in the former posteriorly forms three short tubercles, enclosing as many foveæ, but in the fragment of tooth in the same position forms a prominent lobe, larger than the fifth lobe of the last lower molar of the cave head, and to the antero-external side of this forms another and smaller tubercle, the two enclosing a single fovea.

These characters of comparison which have been presented between the corresponding

last molar tooth of Protochœrus and the cave head may be variable in the same species; but of this we must remain in doubt until further discovery of more material: and until further evidence can be brought to prove the cave head belonged to Protochœrus it will be at least of advantage in the way of reference to consider the former as distinct, and I therefore propose for the animal to which it belonged the name of Euchœrus macrops.

In conclusion, in answer to what may be urged by some naturalists, that the characters given of Platygonus, Protochœrus, and Euchœrus are not sufficient to rank them as distinct genera from Dicotyles, I must add that it will be admitted that the recognised species of the latter present characters in common not possessed by any of the preceding genera, and therefore these should be distinct, and among these new genera differences exist, quite as important as those separating them from Dicotyles. Those who acknowledge the distinction between Machairodus and Felis, Ovibos and Bos, Accrotherium and Rhinoceros, etc., will readily admit this reasoning, and with such naturalists who are so precise as to consider Bison, Bubalus, Bibos, etc., distinct from Bos, or Alces, Tarandus, Cariacus, Megaaceros, and Strongyloceros, etc., from Cervus, the matter is beyond dispute.

Comparative Admeasurements of the head of Dicotyles torquatus, D. labiatus, and Euchœrus macrops.

	D. torquatus	D. labiatus.	E. macrops.
Length of head from occipital condyle to incisive alveoli,	8 in. 3 lines.	9 in. 6 lines.	11 in. 3 lines.
Distance from inion to end of nose,	9 "	10 " 3 "	
" " supra-orbit. foramina to end of nose,	4 " 3 "	4 " 9 "	4 "
Length of os frontis at middle,	*		2 " 1 "
Greatest breadth of forehead,	3 "	3 " 5 "	4 " 5 "
Breadth at anterior glenoid tubercles,	4 "	4 " 9 "	4 " 6 "
" infra-orbitar foramina,	1 " 4 "	1 "10 "	1 "
Length of face from ant-orbital margin to incisive alveoli,	5 " 4 "	6 " 3 "	8 " 6 "
Breadth at canine alveoli,	2 " 6 "	2 " 7 "	2 " 5 "
" lateral incisors,	1 " 2 "	1 " 3 "	1 " 4 "
" ossa nasi at ends of intermaxillaries,			1 " 1 "
Distance between supra-orbital foramina,	1 " 1 "	11 "	1 " 5 "
Height from midway between supra-orbital foramina to level of palate,	2 "10 "	3 " 6 "	3 " 6 "
Height between canines,	1 " 9 "	1 " 9 "	2 " ? "
Height of inion,	3 " 6 "	3 " 9 "	3 " 7 "
Vertical diameter of orbit,	1 " 5 "	1 " 7 "	1 " 4½ "
Transverse " "	1 " 2 "	1 " 2½ "	1 " 7 "
Depth of os mala below orbit,	10 "	1 " 1 "	1 " 8 "
" " from end of post-orbital process,	1 " 2 "	1 " 5½ "	2 " 5 "
From meatus audit. ext. to end of post-glenoid tubercle,	2 "	2 " 6 "	3 "
Length of hard palate,	5 " 6 "	7 "	7 " 9 "
Breadth between first true molars,	11 "	11 "	11 "
Length of upper molar series,	2 " 9 "	3 "	3 " 1 "
Length of hiatus anterior to molars,	7 "	1 " 2 "	1 "10 "
" " " to canines,	8 "	10 "	9 "

* From obliteration of some of the sutures, I am not able to give all the measurements.

	D. torquatus.	D. labiatus.	E. macrops.
Length of lower jaw,	6 in. 6 lines.	7 in. 9 lines.	8 in. 10 lines.
Height from coronoid to angle,	2 " 11 "	3 " 9 "	3 " 6 "
" " condyle " "	2 " 9 "	3 " 3 "	3 " 6 "
" of body at first true molar,	1 " 4 "	1 " 7 "	1 " 6 "
Length of symphysis,	2 " 3 "	2 " 4 "	2 " 10 "
Distance between coronoids,	2 "	2 " 2 "	2 "
" " angles,	1 " 11 "	3 "	3 " 10 "
Length of lower molar series,	2 " 10 "	3 " 2 "	3 " 4 "
" hiatus, anterior to molars,	1 "	1 " 4 "	2 " 2 "

Admeasurements of the teeth in Euchœrus macrops.

Ant. post. diam. sup. post. molar,	9 "
Transverse diam. " " "	$6\frac{1}{2}$ "
Height of crown " " "	6 "
Ant. post. diam. sup. first true molar,	$6\frac{1}{2}$ "
Tranverse " " " "	5 "
Ant. post. diam. sup. third premolar,	$4\frac{3}{4}$ "
Transverse " "	$5\frac{1}{4}$ "
Height of crown " "	5 "
Ant. post. diam. sup. first premolar,	$4\frac{1}{2}$ "
Transverse " " " "	$4\frac{1}{2}$ "
Height of crown " " "	$3\frac{3}{4}$ "
Ant. post. diam. inf. post. molar,	10 "
Transverse " " "	$5\frac{3}{4}$ "
Height of crown " "	$6\frac{3}{4}$ "
Ant. post. diam. inf. first true molar,	$6\frac{3}{4}$ "
Transverse " " "	$4\frac{3}{4}$ "
Ant. post. diam. inf. third premolar,	5 "
Transverse " " "	$4\frac{3}{4}$ "
Height of crown " "	6 "
Ant. post. diam. inf. first premolar,	4 "
Transverse " " "	$3\frac{3}{4}$ "
Height of crown " "	3 "
Length of upper canine along convexity,	3 "
" " enamelled portion externally,	1 " 3 "
" " lower canine along convex margin,	3 " 10 "
" " enamelled portion externally,	2 " 7 "

The existing and extinct species of Dicotylinæ, so far as investigations have extended, appear to be as follows:—

Existing.

Dicotyles torquatus, *Cuvier.*

Dicotyles labiatus, *Cuvier.*

Extinct.

Dicotyles, 5 sp.? *Lund:* Danske naturw. Afh., 1841–2.

Dicotyles Major, *Lund:* Clausen, in neues Jahrbuch für Mineralogie, etc., 1843; Bronn, Index Palæontologicus, Abth. 1, s. 422.

Dicotyles depressifrons, *Le Conte:* Proc. Acad. Nat. Sci., vi. 3.

Probably all the fragments mentioned in the latter communication belong to this animal, except the "four teeth from the upper jaw."

Hyops depressifrons, *Lec.:* Am. Journ. Sci., 2d ser., 5, 104; Proc. A. N. S., vi. 57: "a cranium."

Dicotyles costatus, *Le Conte:* Pr. A. N. S., vi. 5.

Platygonus compressus, *Le Conte:* Am. Jour. Sci., 2d ser., 5, 103; Trans. Am. Acad. Arts and Sci., n. ser., 3, 257. All the specimens represented in the accompanying plates to the latter memoir, I think, belong to this animal.

Hyops depressifrons, *Lec.:* Pr. A. N. S., vi. 57: "fragments of anterior part of head with premolars and canines: the entire dental series of upper jaw."

Protochoerus prismaticus, *Le Conte:* Am. Jour. Sci., 20. 5, 105; Pr. A. N. S., vi. 5.

Hyops depressifrons, *Le Conte:* Pr. A. N. S., vi. 57: "the canine and two inferior molars of lower jaw."

Euchœrus (Protochœrus?) macrops, *Leidy:* hoc opera.

REFERENCES TO THE PLATES.—PLATE 35.

Represents a view of the left side of the skull of Euchœrus macrops two-thirds the size of nature. In the original, the nasal bones are broken, as indicated, and the right intermaxillary only exists; but the latter has been transferred to the left side, being otherwise the best preserved, principally on account of the teeth. The latter visible in the upper jaw, are the canine, the three temporary molars, and the succeeding permanent true molars, the last of which is just commencing to protrude. In the lower jaw are visible a portion of the third permanent premolar ready to protrude, and the succeeding true molars; the last partially only.

PLATE 36.

Two views, one-half the natural size of the skull of Euchœrus macrops.

Fig. 1.—Upper view. The nasal bones in greater part, and the left intermaxillary are broken away, permitting the ossa turbinata, etc. to be seen.

Fig. 2.—View of the base of the skull. The left side of the upper jaw contains the three temporary molars, and the three permanent true molars. The right side, from which the temporary molars were lost, has exposed in their place the permanent premolars.

PLATE 37.

All the figures are of the natural size.

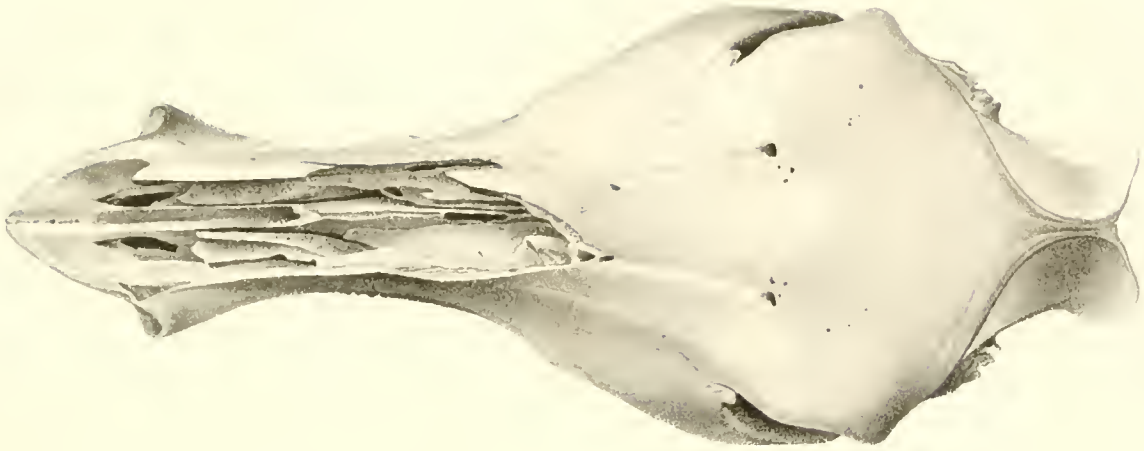
Figs. 1—4.—Molar teeth of the right side of Dicotyles torquatus, represented for comparison.

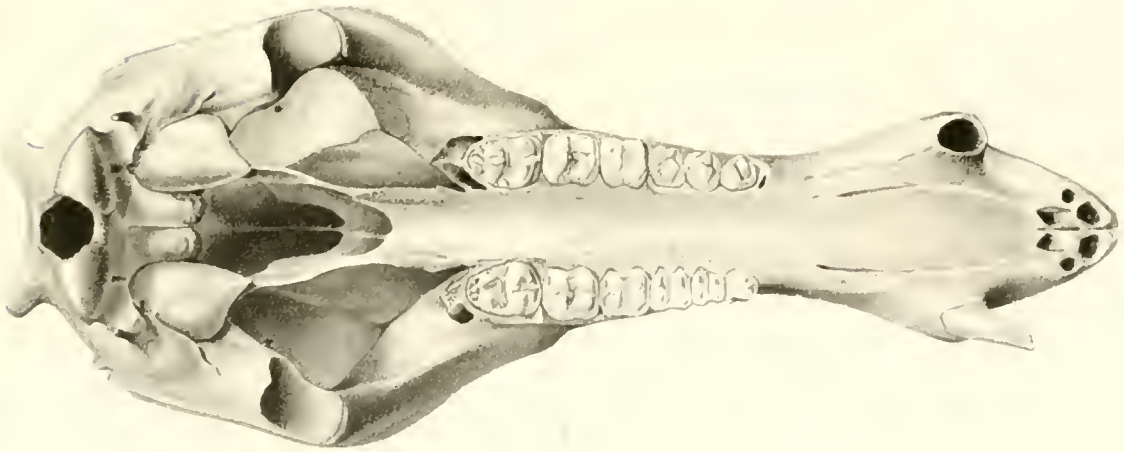
Fig. 1.—View of the triturating surfaces of the upper molars.

Fig. 2.—Outer view of the upper molars.

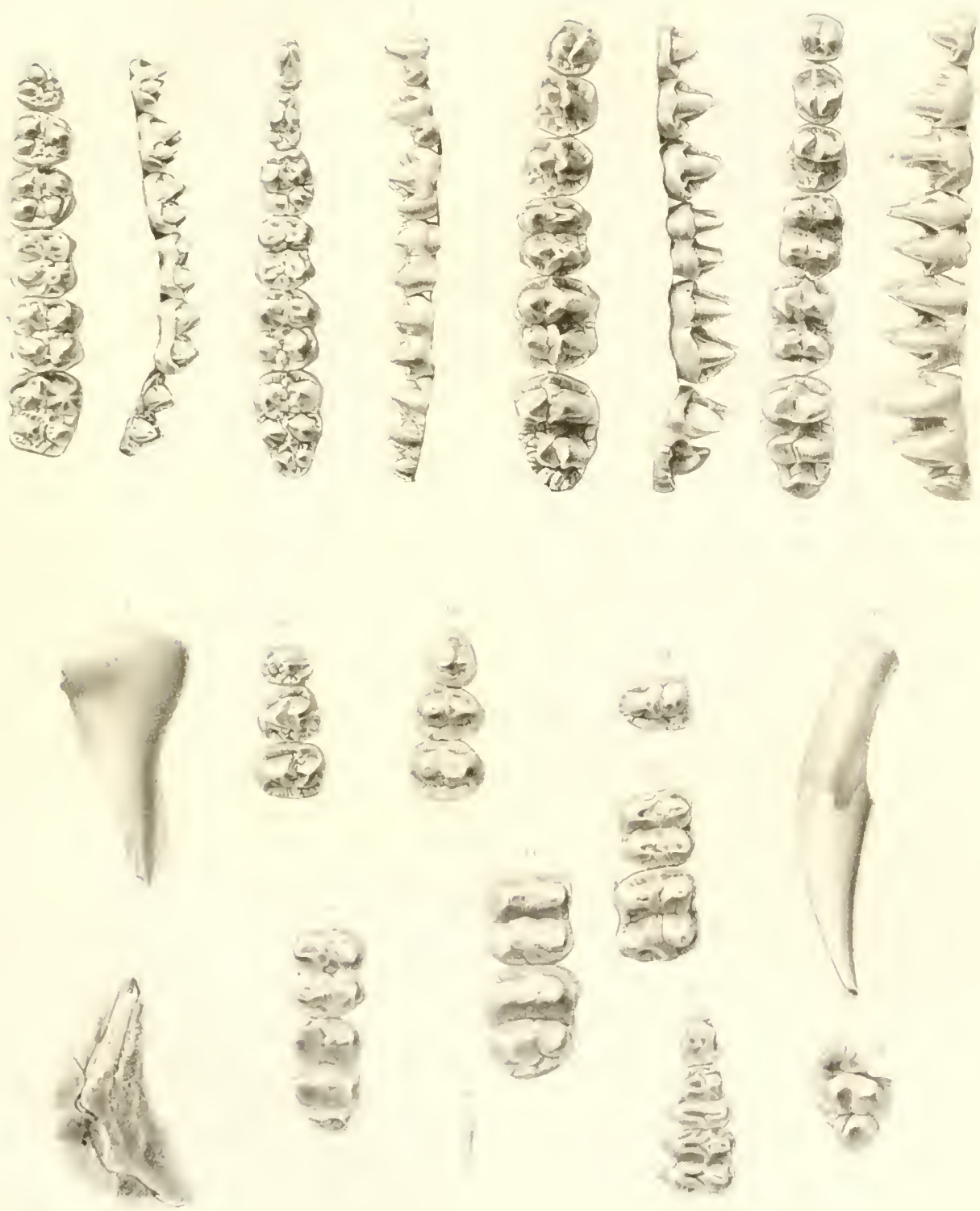
Fig. 3.—Triturating surfaces of the lower molars.

Edes atrox. Leidy





Euchoerus macrops Leidy



1. 4. Dicotyles torquatus. 5. 8. 17. 19. Euchoerus macrops.
9. 16. Platygonus compressus. 18. Protochoerus prismaticus.

Fig. 4.—Outer view of the lower molars.

Figs. 5—8.—Right molar teeth of Euchœrus macrops. The premolars were still concealed within the jaws, and also the last molar partially, but they have been represented as protruded.

Fig. 5.—Triturating surfaces of the upper molars.

Fig. 6.—Outer view of the upper molars.

Fig. 7.—Triturating surfaces of the upper molars.

Fig. 8.—Outer view of the lower molars.

In Figs. 7, 8, the second premolar has been accidentally reversed from its true position.

Fig. 9.—View of the posterior margin of the right side of the lower jaw of Platygonus compressus, exhibiting the extent of curvature of the angle outwardly. Same specimen as fig. 3, pl. 38.

Fig. 10.—The posterior two right inferior molars of Platygonus compressus viewed upon the triturating surfaces. From the same specimens as the previous figure and fig. 3, pl. 38.

Fig. 11.—Upper left premolars of Platygonus compressus viewed upon the triturating surfaces. The first tooth is broken off at the anterior part. From the same specimen as fig. 2, pl. 38. They are unworn, and had not yet protruded from the jaw.

Figs. 12—15.—Upper molars of Platygonus compressus, 12, 13, and 14, 15, from two different individuals; the former very probably belonging to the same individual as figs. 9, 10, and fig. 3, pl. 38.

Fig. 12.—Right upper premolars. The middle tooth in the original has its inner tubercle split to the base, a thin lamina lost from the fissure, and the two portions approached together, so that it appears a little different from that represented by figure 14.

Fig. 13.—Posterior two left upper molars.

Fig. 14.—Middle left upper premolar.

Fig. 15.—First and second left upper true molars.

Fig. 16.—Left canine of Platygonus compressus.

Fig. 17.—Temporary molars of the upper left side of Euchœrus macrops.

Fig. 18.—Right upper last molar, with its anterior part broken off, of Protochœrus prismaticus.

Fig. 19.—Lower lateral incisor of Euchœrus macrops.

PLATE 38.

Fig. 1.—Represents the fragment half the natural size upon which is established the Dicotyles depressifrons. It exhibits portions of the parietal, frontal, nasal, maxillary, intermaxillary, and malar bones.

Fig. 2.—View of the right side of a portion of the face of the natural size of Platygonus compressus. It is the same specimen represented in pls. I., II., of vol. 3, of the *Mem. Am. Acad. Arts and Sci.*, but in this figure the canine alveolus with a portion of the tooth which had been broken off, is reattached. Anterior to the latter, the specimen is obscured by a hard brown mass, apparently consisting of a combination of lime and oxide of iron. Portions of the nasal, intermaxillary, and maxillary bones are seen; and on the left side a portion of the maxillary bone in outline with the three permanent premolars, which had not yet protruded from their alveoli. The latter teeth are represented in figure 11, pl. 37.

Fig. 3.—Portion of the right side of the lower jaw containing the last two molars, the natural size, of an adult individual of Platygonus compressus. A fragment of matrix obscures the angle, and another portion is attached in advance of the condyle.

ARTICLE XXIV.

Chemical Examination of two Minerals from the neighbourhood of Reading, Pa.; and on the occurrence of Gold in Pennsylvania. By Charles M. Wetherill, Ph. D.

1. *Molybdenite.*—This mineral, specimens of which were given to me by Dr. Bischoff and Geo. M. Keim, Esq., of Reading, is found in abundance at the Zion Church, Alsace, in the neighbourhood of that city. It occurs of considerable purity in plates and scales in a quartz matrix. The colour of the latter is like plumbago, but more brilliant. The streak on paper, that of plumbago; on porcelain, olive green. It is impressible to the nail, giving a hardness of 1 by Mohs' scale. 0·7255 grammes weighed in water, 0·565, corresponding to a density of 4·52. The following is its behaviour before the blowpipe. Heated alone on charcoal, white fumes were evolved which coated the coal, and the specimen was left tarnished. Heated alone in the open tube, sulphurous acid was given off. In the platinum forceps, it coloured the outer flame yellowish green. On the platinum wire in the outer flame, gave a glass, yellowish when hot, colourless on cooling; in the inner flame, the glass was greenish. Did not readily dissolve in this bead of microscomic salt. Borax gave similar reactions. Heated with nitre in the platinum spoon, deflagrated with formation of sulphate and molybdate of potassa. Some of the crystalline scales heated in the closed tube gave off a small quantity of water, the quantitative determination of which was effected by raising to a bright red heat in a covered crucible 0·673 grammes of the crushed mineral. The loss after ignition was 0·002, corresponding to a per centage of 0·297 water. A qualitative examination in the moist way detected as ingredients of the mineral, silica, sulphur, molybdenum and iron, the quantitative determination of which is afforded by the following analytical data. 0.2775 grammes of the mineral (which was pulverized with great difficulty, on account of its soft and lamellar nature,) after several days' digestion in aqua regia, left a white residue of silica weighing 0·008, corresponding to a per centage of 2·283. The sulphuric acid yielded on the addition of nitrate of baryta 0·7697, sulphate, which corresponds to 0·106, sulphur, or 38·198 per cent. After removing the excess of baryta salt, the iron precipitated by ammonia weighed 0·0097 or 3·495 per cent. It was proposed to determine the molybdenum as MoO_2 by igniting the evaporated residue according to Rose, in an atmosphere of hydrogen, but an

accident towards the end of the experiment, obliged its determination by loss, which gave a percentage of 55·727. The analysis of the mineral, therefore, gives the following percentage:—

Aq . .	0·297
S . .	38·198
$Si\ O_3$ . .	2·283
Fe_2O_3 . .	3·495
Mo . .	55·727
	100·000

A calculation of the per centage relations of the molybdenum and sulphur, without reference to the other ingredients gives,

S_2 . .	40·668
Mo . .	59·332
	100,000

Dana gives the per centage calculated from the formula MoS_2=sulphur 40·99, and molybdenum 59·01, and Weber in his tables to Rose's analysis, (late edition,) gives for the same calculation, sulphur 41·123, and molybdena 58·877.

2. *Zircon.*—Last summer, Mr. Isaac Lea exhibited to the Academy of Natural Sciences, specimens of Zircon imbedded in magnetic iron, which he obtained from a heap of ore at Eckards' iron furnace, and which was said to have come from a locality eight or nine miles from Reading, N. E. of Pricetown. I received specimens from Mr. Lea, and also from Dr. Heister, from the same heap. Mr. Geo. M. Keim visited, at my request, the locality from whence the ore was obtained, and sent me specimens, and also a few of the same kind which he found in the Mineral Spring Valley, just outside of Reading. The Zircon occurs in large crystals firmly imbedded in the ore, which are in some instances well terminated, but brittle, and detached with great difficulty from their matrix, to which they adhere with such tenacity, that the impression left in the matrix after detaching them is polished, of vitreous lustre and of the colour of the crystals, as if they had been melted in the ore after their formation. Their planes and angles (as noticed also by Mr. Lea) are rounded off in places, as if they had been subjected to an incipient fusion. The largest crystals which I obtained after carefully breaking several pounds of the ore, measured one and a half inches, by one-quarter inch, by three-eighth inch (nearly.) It was distinctly terminated at one end, and showed traces of termination at the other. The usual crystal form was a right prism terminated by corresponding pyramids, the angles of which were frequently modified. The colour, chocolate brown; opaque; lustre, adamantine; planes, as before stated, uneven. One specimen which was too much broken to form certain conclusions, appeared to be part of one of the terminal pyramids. It was highly modified, possessed perfectly sharp edges and glass smooth planes, of adamantine lustre; was on the

edges transparent, like hyacinth, and of deeper colour than the other crystals. The cleavage of the mineral was indistinct and fracture very uneven, but apparently in planes perpendicular to the vertical axis. Hardness, between quartz and topaz, or 7—8 of Mohs' scale. Its powder was brownish yellow, very light. 0·965 grammes weighed in distilled water of temperature 26° C., 0·755 corresponding to a density of 4·595. Before the blowpipe alone in the forceps, and on coal, infusible, *deepens* in colour. The crystals heated to redness in a closed tube give off water, and are unchanged in colour. Does not tinge the blowpipe flame. With borax and salt of phosphorus, gives the reaction of iron. No reaction for manganese on platinum foil with carbonate of soda and nitre, but yields an opaque reddish white mass. Is not attacked by acids. A portion of the mineral finely powdered by washing over, tested for potassa and soda after attacking by concentrated hydrofluoric acid, gave negative results. An examination by the moist way, detected silica, zirconia, iron. The iron present tinged the zirconia green when precipitated by ammonia and hydrosulphuret of ammonium. In a preliminary experiment 0·8985 grammes of the finely powdered mineral exposed to a white heat in a platinum crucible, lost 0·005 which corresponds to a per-centage of 0·556 water. It will be perceived that in its behaviour, this mineral corresponds, with one exception, to zircon, or anhydrous silicate of zirconia. Its water would assimilate it to malakon $2\,(Zr_2O_3SiO_3)+HO$, but it contains less water. Malakon has a lower hardness and sp. gr. than zircon, but by ignition its density is raised to that of zircon. It is supposed by some mineralogists, that malakon is zircon slightly altered by the absorption of water, and by Damour, that water constitutes the difference between them, with which malakon is chemically combined. An analysis of the present mineral is, therefore, interesting, as perhaps throwing light upon the nature of these two species.

The analysis of zircon presents well known difficulties in the separation of its silica and zirconia. According to Scheerer, when water is added to the result of fusing the mineral with carbonate of soda, a gritty powder remains, which is a combination of soda and zirconia, and which by treatment with concentrated hydrochloric acid becomes gelatinous. Gibbs has, however, shown, that besides the above mentioned constituents, this compound contains 24·76 silica, and, that if, after attacking by hydrochloric acid to decompose it, the solution be evaporated to dryness for determining the silica in the usual manner, this silica will be found to contain 30·15 per cent. of zirconia. In an analysis where the silica was determined in the usual manner, I found it contained, beside a small quantity of zirconia, other impurities. In this analysis one gramme of the elutriated mineral (dried at a steam heat) was ignited in a platinum crucible, and the water obtained by loss. Four times the weight of the mineral of carbonate of soda, with the addition according to Henneberg's suggestion of one-eighth nitre, were mingled with the residue in the crucible and exposed to a white heat. The result was found to be well melted, and was treated by water and hydrochloric acid. If sufficient water be present, the acid acts in the cold upon the granular silicate of zirconia soda, perceptibly to the eye, leaving white flakes of silica without the least grittiness. The hydrochloric solution was evaporated with the water-bath to complete dryness, and the residue treated with hydrochloric acid and water.

Since the residue appeared to contain impurities in the silica, dilute sulphuric acid was added, and the whole evaporated until acid fumes began to be evolved. After cooling, water was added, and the silica separated by filtration. To the filtrate was added ammonia and hydrosulphuret of ammonium, the zirconia and sulphuret of iron, after settling, removed by decanting and the iron separated from the zirconia by sulphurous acid according to Berthier's method. The zirconia was, after boiling, filtered and washed, and after decomposing the sulphites and hydrosulphites by nitric acid, the iron was separated from the filtered liquid by ammonia. The addition of phosphate of soda to the filtrate from the oxide of iron, and suffering the beaker to stand in a warm place for several days, gave negative results as to the presence of magnesia. The silica in this analysis was treated twice by concentrated hydrofluoric acid, (which was pure, leaving no residue when evaporated,) and a residue was obtained which, after heating with sulphuric acid weighed 0·038. On boiling this with dilute sulphuric acid to the evaporation of part of the acid, 0·0095 of zirconia was obtained, and 0·0075 silica, which together equal 0·017, leaving unaccounted for 0·021, possibly soda or its salt, in combination with the silica and zirconia. Subtracting the zirconia from the silica, and adding it to that already obtained, this first analysis on one gramme, gave the following per centage results:—

Silica, . . .	36·72
Zirconia, . . .	65·45
Peroxide of iron, . .	2·07
Water, . . .	0·50
	104·74

Both silica and zirconia are here evidently too high. The former two per cent. from the probable presence of alkali; the zirconia also two per cent., from a cause to be mentioned later.

The difficulties presenting themselves in the analysis of zircon are owing, as is well known, to the facility with which its zirconia forms insoluble compounds with silica, and the re-agents necessary to effect its separation. From my experiments on this mineral it would appear, that even the low temperature of the steam bath when water is absent, has a tendency to the formation of basic zirconia compounds, not *readily* soluble even in sulphuric acid. On the supposition that this would not take place by presence of sulphuric acid in considerable excess before evaporating to dryness, and that its silica would be, perhaps, rendered insoluble by the same temperature, I modified its analysis in the following manner, which would appear to be a speedy and accurate method for the analysis of zircon. One gramme of the elutriated mineral, after determining the water by ignition, was fused with four times its weight of carbonate of soda without addition of nitre. Ten minutes' exposure to the heat obtained by forcing a current of air by the table blowpipe through a gas argand flame was sufficient to effect a complete decomposition. To the residue was added a considerable quantity of water, then hydrochloric acid in the cold, without first separating the granular zirconia soda as proposed by Scheerer. The silica remains as pure white flocculæ without any grit. An excess of sulphuric acid is now added and the whole evaporated until fumes of the acid are evolved, at which temperature it is kept for some time. It would be, perhaps, better to add sulphuric acid at

once to the result of the fusion with carbonate of soda and addition of water, and omit the use of hydrochloric acid altogether. The silica filtered rapidly, and after the incineration was almost completely dissolved in hydrofluoric acid. The zirconia and iron were determined as in the first analysis. The zirconia requires a long washing, but filters quickly. Care must be taken in the incineration of this zirconia, otherwise a too high result will be obtained as in the first analysis. When the precipitate is burned in the usual manner, at a low red heat, and until the filter ash is perfectly white, the zirconia remains in shining lemon-coloured irregular masses, which when exposed to a high temperature lose weight. Thus, in my second analysis with one gramme of substance, the weight of the zirconia ignited in the ordinary way, was 0·641, and by successive ignitions at a white heat, was 0·636—0·635—0·635. When it had no longer lost weight, it had a beautiful pearl gray lustre, scratched glass, and gave a brilliant light when heated before the blowpipe. The analysis by this method upon one gramme of the mineral, gave the following per centage results:—

Silica, . . .	34·07
Zirconia, . . .	63·50
Peroxide of iron, . .	2·02
Water, . . .	50
	100·09

The whole crystals of zircon were also raised to a white heat in a platinum crucible, until no further loss of weight—0·997 lost 0·0035, corresponding to a per centage of 0·35 water being less than that obtained from the finely pulverized mineral. The heat was raised gradually, but no glowing of the crystals was observed. After this ignition, they were in lustre more brilliantly adamantine, and darker; although in spots they appeared lighter than originally, as if the iron were not uniformly diffused throughout. As the mineral occurs in a matrix of iron ore, and has apparently been subjected to a high temperature therein, it would seem as if a large part of this iron had been absorbed by cementation. It follows from the analysis of this mineral, that the contents of water alone will not serve as a distinguishing characteristic between malakon and zircon, as Damour proposes; nor that malakon is zircon, altered by the absorption of water as Dana deems possible; but, that the two species are distinct, and differ probably in containing zirconia in two allotropic conditions, as believed by Scheerer. The following are analyses of the two minerals. 1st, Zircon by Henneberg. 2d, Zircon from Litchfield, by Gibbs. 3d, Malakon from Hitterö, by Scheerer. 4th, Malakon from Chanteloube, by Damour.

	1	2	3	4
Silica, ...	33·85	35·26	31·31	31·23
Zirconia	64·81	63 33	63·10	61·70
Iron Perox	1·55	0·79	0 11	2·91
Water	——	——	3·03	3·29
Yttria	——	——	0·34	——
Lime	0·88	——	0·39	trace
Magnesia	——	——	0 11	——
Undecomposed . . .	——	0·39	——	trace manganese
	101 09	99 71	98·99	99 13

W. Henneberg found in his experiments on the effect of heat on zircon, that the condensation after ignition, was as 10,000 to 9798. The density before being 4·615, and after 4·71; and also observed, that at a certain stage, the crystals exhibited a phosphorescence. In my experiments, raising the crystals to a white heat in a platinum crucible, I did not remark any phosphorescence, which was carefully looked for, and the temperature gradually raised. The density of the crystals before and after ignition, was 4·595 and 4·62, corresponding to a condensation as 10,000 to 9946.

Rosé, in the last edition of his Handbuch, suggests the fusion with bisulphate of ammonia, which has never been applied to zircon, as a probable means of its analysis. I performed the experiment very carefully upon 0·961 grammes of the finely pulverized mineral, keeping it as long as possible in contact with the re-agent; but with negative results. The insoluble portion was silicate of zirconia, very white and almost entirely free from iron, while about 1·5 per cent. of zirconia dissolved out, and was precipitated along with the iron. This method, though not applicable to the analysis, may serve to free silicate of zirconia from iron, should it be required to prepare this salt from impure zircon.

3. *On the Occurrence of Gold in Pennsylvania.*—In the spring of 1851, an earth was given to me for examination, of which the locality was not exactly stated, but which was said to have been taken not far from the city, in which gold was detected. The earth was said to have been obtained in digging a well. Several months later, while in Reading, I met with a notice in a German newspaper of that place, which stated that some time previously an earth had been found in digging a well, upon the land of Mr. Yoder, Franconia township, Montgomery county, which proved, upon examination, to contain gold. I have no doubt but that this is the locality of the earth which I examined. Several rocks from the neighbourhood were submitted, consisting of clay slate rock, ferruginous quartz, decayed in places, containing pyrites and magnetic oxide of iron sand. In most of these gold was detected in traces. Some specimens contained no gold whatever. The earth from the well, which was more particularly examined, consisted of sand and gravel, coating in some places fragments of shale or other rock. A careful examination of these with the lens, detected a rather thick spangle of gold adhering to the gravel, and a small rounded mass of a white malleable metal which proved by a microchemical investigation upon half of it to be native tin, which occurs only, according to Dana, in small grayish white metallic grains along with Siberian gold. It melted before the blowpipe, was oxidized by nitric acid, the resulting oxide being insoluble in tartaric acid. Dissolved slowly in HCl, to which solution HS gave the yellowish brown precipitate $SnS+SnS_2$. This occurrence of native tin is strongly opposed to the supposition of fraud in the earth examined. Separating the rock and washing, gave a further quantity of gold spangles very fine, and mingled with pyrites and magnetic oxide of iron, together with more spangles of native tin. One and a half pounds of the original substance, from which these spangles were removed, after separation of the rocks and concentration by washing, were melted with twice their weight of litharge, (previously tested for gold,) and a small quantity of charcoal powder. The resulting button of lead was cupelled (adding to the lead the gold already found) and the

silver treated with nitric acid which left a coherent mass of gold weighing 0·006 grammes. One hundred pounds of the earth would, therefore, contain 0·1 grammes of gold, worth about twenty-six and a half cents.

During a stay at Reading, in the summer of 1851, I noticed a vein of decayed ferruginous quartz, very much resembling the auriferous quartz of North Carolina. It was uncovered in exploring the deposits of iron ore in Penn's Mount behind the city. I neglected at the time to secure specimens, and upon a second visit to the locality this spring, to obtain a quantity for analysis, I found it covered. I obtained, however, from the vicinity a quartz rock, quartz and felspar mingled, and sand, which, on analysis, yielded an exceedingly minute quantity of a brownish powder after treating the silver button resulting from cupellation by nitric acid; but which were too minute from which to derive any definite conclusion as to the presence or absence of gold. A former pupil of mine in an examination of the pyrites of the same locality, thought to have detected traces of gold. I have no doubt, that a more careful examination of the rocks in the vicinity would yield affirmative results in an examination for this metal.

ARTICLE XXV.

On a New Variety of Asphalt: (MELAN-ASPHALT.) *By Charles M. Wetherill, Ph. D. Read July* 16, 1852.

History.—In the spring of 1851, I was called upon to make a chemical examination of this substance in connexion with the late Richard C. Taylor, who was sent to the locality to define its geological position. An unfinished paper, intended for the Transactions of the Society, upon which Mr. Taylor was engaged at the time of his death, is published in the Proceedings for January 16th, 1852. I would refer to this paper and also to a pamphlet, entitled "Abraham Gesner *vs.* Halifax Gas Light Co. Deposition of Richard C. Taylor, respecting the asphaltum mine at Hillsborough, in the county of Albert, and province of New Brunswick," for a full description of the geological situation of the mineral. And, besides the above-mentioned papers, to a pamphlet, entitled "Report on the Albert Coal Mines, &c., by Dr. Jackson," and to an answer to this Report by a "Fellow of the Geological Society of London." Owing to a law suit in which great interests were at stake, the mineral in question has been examined as to its chemical behaviour by a large number of experts, who are singularly divided as to their conclusions. My examination was made at various times, upon specimens obtained from Mr. E. Le Gal, and from the Philadelphia Gas Works, where it is used as a substitute for rosin for increasing the illuminating power of the gas.

Description and Analysis.—In appearance it is of brilliant jet black colour, of high resinous lustre; fracture perfectly conchoidal and brilliant. Hardness between one and two of Mohs' scale. Density 1·097. When very finely powdered and placed in a large bottle, it appears brown when looking at the part adhering to the glass; when coarsely pulverized, is black. If fine particles be chipped from a solid mass of the mineral, and examined under the microscope, they will be found transparent, of brown colour on the thin edges, and where the radiating lines observed in resinous bodies which have a similar fracture, happen to radiate towards the aforenamed edges, fine spicnlæ will be observed at the extremities of some of the radii, perfectly transparent and of brown colour. These results with the microscope had been previously obtained by Dr. Leidy, who made a comparative microscopic examination with the mineral in question, with the asphalts, and with coal.

Thrown into boiling water it became softer to the nail, but could not be moulded between the fingers. Held in the flame of a candle in such manner as to prevent as much as possible the action of oxygen, it gave evidence of incipient fusion, and adhered to paper when placed in contact with it. Thrown into boiling coal tar pitch, it softened, could be kneaded between the fingers like wax, and on cooling presented the same appearance as to fracture, &c., as before. Tested for nitrogen by Lassaigné's method, and for sulphur by fusion with nitre and caustic potassa, affirmative results were obtained.

In an examination for volatile matter, one gramme gave 0.5555 vol. matter, 0·4435 coke, and 0·001 of reddish ash, which corresponds to a per centage of

Coke, . . .	44·35
Volatile matter, . .	55·55
Ash, . . .	0·10
	100·00

The coke, which was very porous, was burned off by a slow current of oxygen introduced into the platinum crucible. A portion of the asphalt in a Hessian crucible with luted cover, was placed in a wind furnace, and the heat gradually raised to full redness, at which it was kept for some time. The coke thus obtained was of light gray metallic appearance, and exceedingly porous, and throughout its mass exhibited laminæ, concentric to the sides of the crucible, like the coats of an onion. A portion of the asphalt was melted by the following process. It was introduced into a Florence flask, to which was adapted a long bent tube for the purpose of condensing and collecting the products of distillation, and placed over a gas lamp; the temperature was carefully and gradually raised. At first white fumes burning with a bright light made their appearance, which were not condensed by the application of cold water. After these, the naphtha came over, with the odour of mineral naphtha, and also somewhat resembling the odour attending the distillation of stearic acid. The asphalt in the flask broke up into smaller pieces, which continued to separate until they became of the size of a small pea; they then fused together and formed a perfectly liquid mass, with gentle ebullition, and of the consistency of molasses, or even more mobile. Some of this poured out into a broken flask, solidified, and when cold, presented a fracture like that of the original substance, but somewhat less brilliant, and which, though quite hard, appeared more impressible to the nail than before fusion. This experiment was performed twice upon the asphalt which was obtained at the Philadelphia Gas Works.* In each case, just before liquefaction, a white sublimate condensed in that part of the tube nearest to the flask. It appeared crystalline and soluble in water; though the re-action was less apparent, owing to the small quantity, and to its being impure from condensed naphtha. Rammelsberg (1st supplement Handwörterbuch des Ch. Theils, der Mineralogie) notices an asphalt from Murindo, Columbia, which according to Mill, contains much Benzoic acid, which can be obtained by alcohol, or by sublima-

* The second experiment was performed upon part of a specimen from the Philadelphia Gas Works, which had been put away and labelled in my cabinet. It was performed to avoid all chances of error.

tion, and which is otherwise unknown. The sublimate from the melan-asphalt may have some connexion with that of Mr. Mill, though its scarcity prevented further examination. Portions of the sublimate and of the melted asphalt were given to the Commissioners at my examination.*

The behaviour of the melan-asphalt towards solvents, compared with that of Egyptian asphalt and cannel coal, is shown by the following table. The object of these experiments with menstrua, was not so much *solution*, as *comparison* of solubility. The conditions were therefore kept as much alike as possible. One thirty-second of an ounce of substance was added to one fluid drachm of solvent. The mixtures stood from Saturday to Monday, and were then boiled for about a minute and left to settle.

	A	B	C
Kind of Menstruum.	*Melan-asphalt.*	*Egyptian asphalt.*	*Cannel coal.*
Lard Oil.	Brown solution, residue.	Like A, but much more dissolved.	Not tried.
Linseed Oil.	do.	do.	No solution.
Naphtha distilled from the rocks at the locality of the melan-asphalt.	Deep brown solution, residue.	Like A, more in solution.	No solution.
Mineral Naphtha.	do.	do.	Not tried.
Wood Naphtha.	No solution.	Solution light yellow.	Not tried.
Purified Coal Naphtha.	Brown solution. Less residue than by preceding solvents.	Very soluble, but little residue.	Not tried.
Turpentine.	Soluble, with residue.	Soluble, with little residue.	No solution.
Chloroform.	Quite soluble. Residue.	Soluble, no residue.	No solution.
Ether.	Light yellow solution.	Deep brown solution.	Light yellow solution.
Absolute Alcohol.	Alcohol not coloured.	Light yellow,	Alcohol not coloured.

When raised to the boiling points in coal-tar and coal-tar pitch, the melan-asphalt was softened that it might be moulded into any shape, and when hard on cooling, its fracture was the same as before the experiment. The Egyptian asphalt disappeared completely, while the cannel coal was not in the least affected.

From the experiments made with a view to the solubility of the asphalt in several menstrua, I would infer that its solubility depends much upon the fineness of the powder and length of time of the action. A flask was half filled with oil of turpentine, and to its neck was adapted, by means of a cork, a bent tube, to which was melted one of larger diameter in connexion with a Liebig's condenser, so that the whole system made an obtuse angle with the axis of the flask. Pieces of the asphalt of the size of a hazelnut were introduced into the widened tube, and the turpentine brought to the boiling point. The turpentine vapours condensing upon the asphalt took it in solution pouring down again

* I find by a subsequent experiment, that the fusion is not facilitated by an atmosphere of carbonic acid. Melan-asphalt, like amber, (which it much resembles) appears more readily soluble after fusion. After fusion it is electric. I have never found any difficulty in fusing melan-asphalt in a flask; but the experiment requires to be performed with care.

into the flask. This method of solution proposed by Mansfeld as an easy mode of attacking the resins was found of little avail for the substance under experiment. A deep brown solution was at length obtained, but requiring a longer time than by subsequent methods. If the substance be powdered ordinarily fine, the solution is more readily effected by oil of turpentine;—and the solution is still more easy if it be pulverized extremely fine and passed through bolting cloths. The successive additions of turpentine are all coloured. If, after treating once with oil of turpentine, oil of peppermint be added to the residue, a fresh quantity appears to enter into solution; and if coal naphtha be added to this residue, another portion of the asphalt will be dissolved. E. Durand, of this city, obtained for the solubility of Cuban asphalt, thirty-four parts in ether—sixty in oil of turpentine, and six residue; and of melan-asphalt in ether four, in turpentine thirty, and residue sixty-six.

Dr. A. A. Hayes, in two experiments, obtained from two hundred parts of melan-asphalt, by action of oil of turpentine, seven and three-tenth parts, and five and seven-tenth parts, dissolved. Dr. Hayes tried the action of other solvents, the residue from which, without further examination, he pronounced coal. The residue, from my experiments with solvents, when examined under the microscope with moderate powers, presents all the brilliancy of lustre and transparency on the thin edges with brown colour, of the original substance. If the finely powdered asphalt be examined with the microscope before action with solvents, particles will be observed here and there of such fineness as to transmit brown light; mingled with these are others, thick, of brilliant black colour, and opaque, but on the edges of some, thin enough to be transparent. If the residue be examined during the action of the several solvents, these fine fragments will be observed to disappear gradually, until at last the coarser ones alone remain, and which are here and there thin enough at the edges to be transparent. The experiments of solution are beautifully exhibited on thin scrapings in a watch glass with the solvent in the field of the microscope. In the case of the very minute particles, an almost invisible skeleton of the earthy constituents is left. Comparative experiments with asphalt from Cuba and with melan-asphalt gave the following reactions. The substance was not very finely powdered. The shades were deeper in the case of the Cuban asphalt.

With Naphtha, . . .	Deep brown solution.
Oil of Vitriol, . . .	Deep brown solution.
Caustic Potassa, . .	Slightly yellow.
Cold Nitric Acid, . .	No action.
Boiling Nitric Acid, . .	Light yellow resulting liquid.

Mr. William Rice, manufacturer of marine paint in this city, states, in a letter to the late Richard C. Taylor, that he found the asphalt in question to dissolve in coal tar, coal tar pitch, coal naphtha and turpentine, with the formation of a beautiful varnish.

Organic Analysis.—The combustion of melan-asphalt with oxide of copper gave for 0·858 grammes; carbonic acid 2·707, and water 0·6925. For nitrogen, by Erdman and Marchand's method, 0.589 gave twenty-three cubic centimetres of moist nitrogen, at 12°C. and 763·4 millimetres barometric pressure, for which the usual corrections were made.

A specimen of asphalt from Cuba was analyzed at the same time. Its density was 1·117, its relations of vol. matter, &c., as follows:—

Coke,	32·00
Vol. Matter.	67·60
Ash,	0·40
	100·00

The percentage relations of the two analyses are as follow:—

	Cuban Asphalt.	Melan-Asphalt.
Carbon	82·339	86·037
Hydrogen	9·104	8·962
Nitrogen	1·910	2·930
Sulphur	traces	traces
Oxygen	6·247	1·971
Ash	0·400	0·100
	100·000	100·000

Subtracting the ash, and uniting the nitrogen and oxygen, we have

	Cuban Asphalt.	Melan-Asphalt.
Cuban	82·670	86·123
Hydrogen	9·141	8·971
Oxygen and Nitrogen	8·189	4·906
	100·000	100·000

Taking carbon one thousand, we have in

	Cuban Asphalt.	Melan-Asphalt.
Hydrogen	110	101
Oxygen and Nitrogen	99	57

In calculating the formula for the Cuban asphalt, neglecting the nitrogen, it would give $C_{35}H_{23}O_2$. The formula for melan-asphalt would be $C_{68}H_{43}O,N$, in which the number of equivalents of C and H for one of O, is nearly fourfold that in the case of the Cuban asphalt.

The melan-asphalt, like that from Cuba and Egypt, becomes *highly electrified by friction*. Coal does not present this phenomenon.

The question as to the constitution of the asphalts, with a view to their classification, has been much neglected by chemists, yet it is an interesting one, as throwing great light upon their origin, which remains in a state of uncertainty. Among the bitumens and asphalts, there exists a great variety as to external appearance, consistency, solubility, and proportion of elementary constituents. Boussingault in his "Memoire sur la Composition

des Bitumes," (Ann. de Ch. and Ph., lxiv. 141,) has sought a classification with regard to their contents of Petrolène and Asphaltène, which he supposes would account (by varying mixtures) for the above mentioned differences.

Petrolène, from his experiments, contains

Carbon,	88·5
Hydrogen,	11.5
	100·0

and is isomeric with oil of turpentine. Asphaltène is $C_{20}H_{16}O_3$ containing

Carbon,	75·0
Hydrogen,	9·9
Oxygen,	14·8
	99·7

The bitumen of Bechelbronn, which, according to Boussingault, is a mixture of 85·4 petrolène and 14·6 asphaltène, contains,

Carbon,	86·8
Hydrogen,	11·2
Oxygen,	2·0
	100·00

The asphalt from Coxitambo bears a great analogy to the melan-asphalt. According to Boussingault, "its fracture is largely conchoidal, it is of great brilliancy, and would be taken from its black colour and lustre for obsidian." Its density (Loewig, from Boussingault) is 1·08. It dissolves *with great difficulty* in petrolène and in the fat oils, which Boussingault supposes to arise from "the great cohesion of the natural asphalt." By a later analysis by this celebrated chemist, (Ann. de Ch. and Ph., lxxiii.) it has the following composition, which will bear comparison with my results for melan-asphalt.

Carbon,	88·63
Hydrogen,	9·69
Oxygen and Hydrogen,	1·68
	100·00

From the foregoing analysis and behaviour I infer that the substance from Hillsborough is not coal, nor any variety of coal, but a true and a new variety of asphalt. In allusion to its beautiful and brilliant black colour, I propose for it the name melan-asphalt.

ARTICLE XXVI.

On the Decomposition of the Alkaline Sulphates by Hydrochloric Acid and Chlorine.
By R. A. Tilghman. Read June 18, 1852.

From the fact of the decomposition of the sulphates of baryta, strontia, and lime, by the contact of a current of vapour of water at a high temperature, we are naturally led to investigate the action of other bodies of similar constitution under the same circumstances. Substituting chlorine for oxygen in its combination with hydrogen, we have hydrochloric acid gas in the place of water; and it will be remembered that chlorine in some cases exhibits more powerful electro-negative energies than oxygen; thus, the chloride of hydrogen is a strong acid, while the oxide is a neutral substance, and the chlorides of the alkaline metals are neutral, while their oxides are strong alkalies.

It would seem probable, therefore, that the action of hydrochloric acid gas upon the sulphates above named, should be more powerful than that of vapour of water.

A current of hydrochloric acid gas was dried by passing through pumice drenched with sulphuric acid, and then conducted by a platinum tube into the bottom of a deep and narrow platinum crucible, which was filled with small pieces of sulphate of baryta, and the whole heated to high redness by a gas flame urged by a strong jet of air.

After half an hour's heat, the contents of the crucible were boiled in water, giving a solution neutral to test paper, which was found to consist of chloride of barium. An analysis of the portion nearest to the influx of the gas, showed that twenty-seven per cent. of the sulphate of baryta had been converted into chloride of barium; a decomposition considerably greater, judging from former experiments, than would have been effected by vapour of water in the same time, and at the same heat. This experiment was repeated by passing the dry hydrochloric acid gas over the sulphate of baryta, heated in a porcelain tube; the escaping gases were passed through water in a Woulfe's bottle, and the incondensable portion collected in a gas bell. The water in the Woulfe's bottle was found to contain, besides the excess of hydrochloric acid, a considerable quantity of sulphurous acid, and a trace of sulphuric acid. The incondensable gas proved to be oxygen. About one-half of the sulphate of baryta had been converted into chloride of barium, the fusing of which, by preventing the free contact of the hydrochloric acid gas with the undecomposed sulphate, causes the action to become slower and slower.

The reactions which take place in this decomposition are very simple, being precisely the reverse of those which occur in the production of hydrochloric acid, by the action of sulphuric acid on a chloride. One atom of water is formed from the hydrogen of the hydrochloric acid, and the oxygen of the baryta; their two remaining elements combine to form chloride of barium, while the sulphuric acid is set free in the state of sulphurous acid and oxygen.

The sulphates of strontia, lime, and magnesia, are decomposed in the same way as sulphate of baryta by hydrochloric acid gas.

The sulphates of potash and soda, when exposed in a platinum crucible at a high red heat to a current of dry hydrochloric acid gas, after some time give dense fumes of the volatilizing chlorides, large portions of which are also found in the fused salts.

Moist hydrochloric acid gas as evolved by boiling dilute hydrochloric acid acts in a similar manner, but rather less quickly than the dry gas. Sulphuric acid is known to be expelled at a high heat from its combinations, by several acids, such as phosphoric, arsenic, and boracic, whose affinities at common temperatures are less powerful than its own; but as all these acids are fixed at heats which volatilize sulphuric, it is to this property that their action has generally been attributed. In the present case, however, both the hydrochloric acid and the chlorides produced, are more volatile than the sulphuric acid and the sulphates decomposed. Rose has recently shown that the alkaline sulphates can be decomposed into chlorides by ignition with a large excess of sal ammoniac; but, in this case, the reducing agency of the hydrogen of the ammonia upon the sulphuric acid of the salt, must play an important part in the decomposition, and entirely distinguishes the action from the one now in question.

As in the above experiments both elements of the hydrochloric acid enter into combination with the constituents of the decomposed salt, and aid in producing the decomposition, it became a matter of interest to examine the action of the chlorine alone under the same circumstances.

A current of chlorine gas liberated from hydrochloric acid and peroxide of manganese, was washed with water to remove any traces of hydrochloric acid, then dried by sulphuric acid, and conveyed by a platinum tube through small pieces of sulphate of baryta heated to high redness in a platinum crucible. After an operation of half an hour, the pieces of sulphate of baryta were found converted on their exposed surfaces into chloride of barium, the action appearing to be nearly as powerful as in the case of hydrochloric acid gas. In this experiment the chlorine must expel both the sulphuric acid of the salt and the oxygen of the base, a decomposition which might be more simply expressed in the language of Davy's Binary theory of salts, by saying that the simple radical chlorine replaces the compound radical SO^4, the sulphat-oxygen of Graham, in its combination with barium, sulphurous acid and the two equivalents of oxygen, being the gaseous products of the decomposition.

Vapour of iodine passed over sulphate of baryta, under the same circumstances, forms a considerable quantity of iodide of barium, but the action seems less energetic than that of chlorine.

In taking a general view of this class of decompositions, some cases present themselves rather difficult of explanation.

In the instances of the decomposition of sulphate of baryta by hydrochloric acid gas, chlorine, and iodine, it is to be observed that the reverse action is known to take place when anhydrous sulphuric acid is passed over the chloride or iodide of barium at a red heat, chlorine and sulphurous acid being evolved, and sulphate of baryta being formed. In this respect the case resembles the well known reciprocal decomposition of vapour of water at a red heat by metallic iron, and of the oxide of iron thus produced by hydrogen. The chlorine and sulphuric acid having each a strong and possibly nearly equal affinity for the base, we can imagine that the successive preponderance of the one or the other might be determined by the presence of an excess or atmosphere of the decomposing gas.

At the heat at which sulphate of baryta is decomposed by vapour of water, its base forms a stable hydrate, and its affinity for water may be viewed as aiding the decomposition. So, also, at the other end of the scale, sulphate of magnesia is decomposed at a heat which allows of the existence of sulphuric acid in combination with water.

But in the case of the decomposition of the sulphate of lime by vapour of water, neither of these affinities can assist the action. At the temperature employed no hydrate of lime can exist, and neither the sulphurous acid nor the oxygen, into which the sulphuric acid resolves itself, shows any marked attraction for vapour of water.

We have, therefore, an instance of a powerful affinity between two bodies being overcome by the mere presence of a third, with which neither of them has any inclination to combine.

It is probably to the action of heat in weakening the intensity of all kinds of attraction, as well chemical as mechanical, that we are to look for an explanation. The experiment of Grove in the decomposition of water, shows that the most powerful chemical affinity can be overcome by a sufficiently intense heat.

Co-operating with this, is the tendency of substances to diffuse themselves into a foreign atmosphere, which Graham has shown, in the case of liquids, to be a force capable of producing by itself chemical decomposition.

ARTICLE XXVII.

Notes on the Classification of the Carabidæ of the United States. By John L. Le Conte, M. D.
Read March 18, 1853.

The object of the present investigation is, an attempt to classify the great family of Terrestrial Predaceous Coleoptera, in such a manner as to exhibit to some extent the natural affinities of the genera among themselves, and to establish natural groups, which may be recognised without the aid of sexual characters. In all the systems already proposed, however natural may be the mode of division, it is frequently a matter of impossibility to determine the genus, if the specimen should be a female; and in such cases we have nothing to aid us except the empirical characters derived from the general appearance of the insect.

The first attempt to establish such natural divisions in the family of Carabidæ is, apparently, the arrangement proposed by Erichson in his very philosophic and concise Käfer der Mark Brandenburg. This arrangement, with a different subordination of characters, and the introduction of some new considerations, forms the ground work of the classification herein contained. The isolated groups have been carefully examined and commented upon by Chaudoir, with great detail and accuracy, in various essays contained in the Bulletin of the Soc. Imp. des Naturalistes de Moscou: the great detail with which his descriptions are made, enables the student to form a very clear idea of the true affinities of his genera, although, perhaps, the differences upon which they are founded are occasionally suitable rather to define a group of species, than a natural genus.

The attempts at classification on the part of the French naturalists do not appear to have been equally successful. The standard work of Dejean shows evidence of this by the continual doubts expressed as to whether species described should belong to the genus in which they were placed, or to some other. Sometimes the same doubt is shown about the position of a genus, or even of a group of genera. The other French Entomologists, with but few exceptions, have adopted the system of Dejean, which was based upon earlier observations of Latreille. The classification proposed by Laporte in his Etudes Entomologiques, makes several very necessary innovations, but his characters are in general too loose and faulty to be useful, although the groups mostly appear natural. That of Brullé in the Suites à Buffon, possesses great merit, from the clearness of

his definitions, and from many happy suggestions regarding the affinity of difficult groups. The classifications adopted by English naturalists are mainly based upon Latreille's system, very slightly modified. That offered by Haliday (Entomologist, 185,) is a remarkable exception, the structure of the prosternum being for the first time used as a character for natural division in this tribe.

However applicable and satisfactory these arrangements may be when applied to a local fauna, they have all failed when applied to a more extensive series of genera, so that after all these systems, there are yet many genera, which, when placed in the groups with which they seem properly to belong, violate the rules of the system. Thus if Galerita enters Erichson's group *Brachinini*, it would be impossible for the nearly allied Helluo to do so; although these are certainly much more closely related than Brachinus and Lebia: while in other cases (Anchomenini, Pterostichini, Trechini, Chlæniini) the characters are almost entirely sexual.

The great difficulty, in all investigations of this nature, is the determination of the true value of the differences of organization, which are co-extensive with the groups: in proportion as these are properly subordinated our classification becomes natural. Having once established the limits of our smaller groups upon distinct characters, we may then use those which are dependent on sex, or other condition, for the purpose of investigating the relations existing among these groups. In proportion to the extent of a series, and the number of types existing in it, will be the difficulty of giving a clear limit to the variation of the series, and of furnishing a definition which will distinctly indicate such series.

The characters founded upon modifications indicating particular modes of life, are in general, I think, unsafe; because animals must be looked upon as machines, which work always in the most effective manner; and thus the habits of life would follow from the modifications of structure, which form part of the system of variation, and but rarely from those great and fundamental differences which distinguish the types in nature. Thus, for example, the division of birds into land birds and water birds, is eminently unnatural; for although it may be asserted, with some plausibility, that the webbed feet of the latter were given them *for the purpose* of enabling them to swim, no *earthly* reason can be given why the embryo of a land bird at an early stage of development should also have webbed feet, unless we stupidly shut our eyes to all provision or design in nature, and say: the animal lives in a liquid, and therefore it must have swimming organs, entirely irrespective of what may be its habits when fully developed. In mammalia this system of classification has long been discarded, and we find the aquatic species partitioned among the various groups, to which, by their assemblage of characters, they seem most closely allied, leaving only a small group, Cete, which are typically aquatic.

Applying similar considerations to the large series of pentamerous predaceous Coleoptera, I have been led to select other characters than those usually adopted for the division into Adephaga and Hydradephaga, which depend on the form of the feet. On closely investigating the nature of the parts supporting the feet, which assume this peculiar natatory form, I was delighted to find that the coxa showed a modification in form which has

heretofore been unnoticed. In the natatory genera, the posterior coxa is larger than in the terrestrial genera, and extends completely to the side of the abdomen, thus cutting off all articulation between the epimera of the metasternum and the ventral surface of the abdomen: now the effect of this is to give an increased attachment for the muscles moving the long posterior legs, so that they may have the requisite power for swimming. The teleologist might say that this was a simple effect of the natatory legs: unfortunately, however, there happens to be a genus found in California, which, with this form of coxa, (reduced only a little in size,) has perfectly ambulatorial feet, so that in this case it is evident that the enlarged coxa, a zoological character, having only indirect relation to the manner of life, has considerably more value in establishing the relations of the two organisms than the mechanical character of the form of the legs.

Leaving the full development of these considerations, which belong more properly to transcendental zoology, I will proceed to sketch out the general facts by which I have been guided in my arrangement of Geodephagous Coleoptera.

In the first instance we have two very distinct forms recognised by most entomologists as types of distinct families. These are the Cicindelidæ and ordinary Carabidæ. The definition of the first family has been gradually modified according to our more accurate knowledge, until finally it rests merely on the character proposed by Erichson, "ligula cornea, inflexa, paraglossis nullis." On close comparison I find that the antennæ are differently placed in the two families, being on the front above the base of the mandibles, in Cicindelidæ, and behind the base of mandibles in the genuine Carabidæ. Another very remarkable difference of a sexual character is, that the abdomen of the male is composed of seven ventral segments, while the female has but six, as in ordinary Carabidæ.

Having now isolated the Cicindelidæ, we may pass on to the consideration of the second family, as the very complete essay of M. Lacordaire* leaves nothing to be added. A classification of the numerous species found within our country requires a synopsis, and must be deferred for a more appropriate occasion.

In glancing over a large series of Carabica, it is evident at first sight that there are at least six distinct groups, viz., Lebia, Pterostichus, Harpalus, Chlænius, Scarites, and Carabus: although there may be gradations from one to the other, yet the eye singles these out as being the types of different divisions. In comparing these with each other we find a general correspondence of those characters which separate them from Cicindelidæ, but in the more intimate structures we find a great difference. The form of the anterior tibiæ has been used by Erichson, and of the sternum by Haliday: these appear so different in form in genera which are closely allied, that it is obvious that their importance in establishing the primary divisions has been unduly estimated. On comparing together the before-mentioned six types, I found that a character exists in the side-pieces of the mesosternum, which would give us a primary division apparently free from objection. In the ordinary Lebia, Pterostichus, &c., this side-piece is quadrilateral, with a fine scarcely perceptible suture along its posterior margin. In Scarites and Carabus this fine posterior suture,

* Revision de la Famille des Cicindélides, &c. Mem. Soc. Roy. des Sciences de Liége. Tome I.

separating the epimera and episterna, is advanced so that the posterior portion becomes triangular, and the suture is diagonal. For convenience, in the descriptions which follow, I have termed these quadrangular pieces "epimera;" and although it is evident they are composed of the epimera and episterna together, it was thought that this term, though not strictly accurate, was obvious in its meaning, and preferable to the introduction of an unusual expression. The diagnosis of the first division will, therefore, be "epimera mesothoracis non diagonaliter divisa;" and, of the second, "epimera mesothoracis diagonaliter divisa."

In the isolation of the different types composing the first of these divisions, it was found that Erichson's definition of his group Brachinini, would not apply to many of our genera, which were evidently closely related with genera already contained in his group: it thus became necessary to seek for new characters. In comparing together the different genera with truncate elytra, it was seen that Brachinus, distinguished by its singular power of producing explosions, differed not only from all other genera with truncate elytra, but from all other Carabidæ, by having seven ventral segments in the abdomen; thus violating the diagnosis of the entire family, as given by Erichson. Yet it was evident that the Brachini did not constitute a separate family, of the same rank as the Cicindelidæ, but were rather to be compared with the two divisions already established on the form of the epimera of the mesothorax. In this respect the Brachini appeared to come closer to the second series than to the first.

We now, therefore, have three sub-families, easily distinguished from each other, and which may be called Brachinini, Harpalini, and Scaritini.

In taking up the second of these, containing the great mass of the Carabidæ, and recurring again to those with truncate elytra, it was found that a certain set, typified by Lebia and Cymindis, passed by insensible gradations into those having the elytra not truncated, as Platynus, and thus to Pterostichus, all distinguished by having the anterior tibiæ slender, or but slightly thickened, while Helluo had the same organs broad and strongly compressed, so that both the truncate elytra and the structure of the anterior tibiæ failed to define the group. While comparing together Helluo with Galerita, no difference was perceived excepting those already pointed out; but, in comparison with Cymindis, the ligula was found to be destitute of the paraglossæ, which although connate with the ligula in the greater number of genera having truncate elytra, are still distinct. On further comparison this absence of paraglossæ was found to be a character of all the genera which were suspected to have any affinity with Helluo, such as Galerita, Anthia, Morio, however different might be the form of the tibiæ and elytra. This, then, was obviously a point of fundamental importance, since it brought together genera, the affinities of which had been recognised, although by the ordinary classifications they had been widely separated. On farther consideration I was induced to consider Panagæus as related with these genera, rather than with Chlœnius or Badister.

Another peculiarity which distinguishes this set of genera is the tendency to abnormal pubescence on the antennæ, the difference between the glabrous and pubescent points, so obvious in most of the Carabidæ, being here by no means plain: some genera, as Gale-

rita have the antennæ nearly equally hairy, while in Morio, the outer joints are much less pubescent than usual.

Having eliminated this set, which contains nearly all the anomalous genera of difficult location, our task was reduced to finding sufficient differences to isolate the three remaining types, Pterostichi, (including Lebia,) Harpalus, and Chlœnius: after trying every means in my power, I have been compelled to rest the first and third almost upon sexual characters, which are here co-extensive with each group: the second group cannot rest upon sexual characters, as we there find such structures variable, not only in allied genera, but even in the same genus: the only character found to distinguish it, is, that the third joint of the antennæ is more or less pubescent, while in all the genera of the other two groups, with the exception of Badister and some genera allied to Casnonia, that joint is entirely glabrous. This difference is not altogether satisfactory, but it seems to be the best that can be obtained, and if we find the groups into which these divisions may be separated so distinct that there will be no possibility of confounding them, we may use these slight characters as indicating the existence of affinities in series, which series, although manifest in nature, cannot be defined.

The diagnosis of the groups, as subsequently given, will show that such has been done, and that the groups themselves rest upon characters independent of sexual modifications. The only cases in which confusion can arise, are in the osculating instances just mentioned: where the Lachnophori osculate with Galerita, and Badister with Stenolophus. Between Chlœnius and Pterostichus there is an osculation also, so that for the separation of these groups we must rely on the empirical character that the Chlœnii are all pubescent, and the Pterostichi glabrous.

Passing now to the third subfamily, Scaritini, we find in it the following types, which are obviously distinct: Ozæna, Scarites, Bembidium and Carabus, besides Broscus and its allies, and Omophron, the position of which might be questionable.

The differences in the parapleuræ cannot yet be employed, for in the allies of Scarites we find great variations: the form of the prosternum must also be postponed, for Elaphrus and Omophron are both close relations of Notiophilus.

The tibiæ, however, present important differences, those of Scarites being produced very much at the external apical angle, giving rise to the form that is called palmated: in this group, and in one or two genera (Promecognathus) which, though not belonging to the group, show very great affinities with it, the parapleuræ are unusual in form, so that throwing out for the present Promecognathus, we can get good definitions for the four principal types, Ozæna, Scarites, Bembidium, and Carabus.

With regard to Omophron, on examination, there is found to be no important difference between it and Elaphrus, except in the form of the sternum; and as we already know the variations in that part of the body by comparing Elaphrus and Notiophilus, it is safer to place Omophron with the Carabi, to which its simple anterior tibiæ and parapleuræ show its affinity. With regard to the remaining genera not included in the four groups, they are Promecognathus, Metrius, Broscus, and Haplochile, and some foreign genera, considered as osculant between Morio and Ozæna, with both of which indeed they

seem to have strong affinities; by the form of their epimera, however, they belong to the present subfamily, and only indicate an osculation with the first division of the second subfamily.

Promecognathus, by the form of the mandibles, labrum, in short of every part of the body except the legs, indicates an affinity with Scarites: Broscus appears to be related to Promecognathus, by the antennæ, ligula, and legs, but differs in the parapleuræ being appendiculate: Metrius agrees with Broscus in every respect except form of body; the thorax being closely united to the trunk, and the prosternum produced posteriorly as in the Carabi. Haplochile leads off towards Morio, and Ozæna, differing from the latter by the form and insertion of the antennæ, but agreeing in these organs with Metrius. In view of these affinities, I have classed all these genera in one group, placed between Ozæna and Scarites, and distinguished by having the four basal joints of the antennæ glabrous, and the anterior tibiæ emarginate and not palmated. The distinctions between them and the Carabi are not obvious, as one genus of the latter, Loricera, has the anterior tibiæ tolerably deeply emarginate. In the case of the genera of Carabi allied to Loricera, the base of the maxillæ is strongly spinous or bearded, while in Promecognathus nothing of the kind is seen. This will furnish an unfailing mode of distinguishing the two groups where the diagnosis seems imperfect.

Besides the osculation between the Psydri and Moriones of the preceding subfamily, there is also an osculation between the Bembidia and the Pterostichus series through the Trechi: this osculation is so close that Patrobus seems equally well placed in either division: this genus and Pogonus are the only ones which I have seen in which the application of my method of arrangement leads to doubtful results. The other genera of Scaritini show no approximation towards the groups of the preceding division, except in the relation between Cychrus and Panagæus: the relation between Ditomus and Scarites seems to me to have been much exaggerated.

The point of osculation between the Carabidæ and Cicindelidæ seems to occur in this subfamily, in the Elaphri: a nearly allied genus of the Carabi (Opisthius) furnishes the nearest approach to an osculation with the water beetles.

ADEPHAGA.

Coleoptera pentamera, prothoracis epimeris et episternis distinctis; abdominis segmentis tribus primis connatis.

Subseries 1. Coxæ anticæ globosæ in prosterno sitæ, posticæ ad abdominis marginem non extensæ: *Cicindelidæ* et *Carabidæ*.

Subseries 2. Coxæ anticæ præcipue globosæ, raro transversæ, inter prosternum et mesosternum insertæ; coxæ posticæ ad abdominis marginem extensæ: (pedes postici sæpissime natatorii:) *Amphizoidæ*, *Haliplidæ*, *Dytiscidæ* et *Gyrinidæ*.

Fam. 1. CICINDELIDÆ.

Antennæ in frontem supra mandibularum basin insertæ, articulis 4 primis glabris; ligula brevissima inflexa, palporum labialium stipite libera: tibiæ anticæ tenues non emarginatæ;* abdomen maris 7-, feminæ 6-articulatum.

Fam. 2. CARABIDÆ.

Antennæ ad mandibularum basin sitæ, articulis basalibus plus minusve glabris: ligula porrecta, paraglossis sæpissime distinctis: abdomen sexus utriusque conforme.

Subfam. 1. *Brachinini.*

Abdomen sexus utriusque 7-articulatum: epimera mesothoracis fere diagonaliter divisa; parapleuræ appendiculatæ: tibiæ anticæ tenues emarginatæ.

Subfam. 2. *Harpalini.*

Abdomen sexus utriusque 6-articulatum; epimera mesothoracis non diagonaliter divisa, parte posteriore brevissima: parapleuræ appendiculatæ; tibiæ anticæ emarginatæ.

A. *DRYPTÆ.*

Tibiæ anticæ tenues vel dilatatæ, apice non spinulosæ.

Antennæ art. 4 primis plus minusve glabris.

Ligula dilatata, paraglossis nullis.

Tarsi maris, quando dilatati, papillis raris instructi.

B. *PTEROSTICHI.*

Tibiæ anticæ tenues, vix spinulosæ, vel apico incrassatæ et spinulosæ.

Antennæ art. 3 glabris, rarius 4 subglabris.

Ligula paraglossis distinctis.

Tarsi maris antici dilatati, subtus papillis seriatis instructi.

C. *HARPALI.*

Tibiæ anticæ incrassatæ, plus minusve spinulosæ.

Antennæ articulis 2 glabris.

Ligula paraglossis distinctis.

Tarsi maris varii.

D. *CHLÆNII.*

Tibiæ anticæ plus minusve incrassatæ.

Antennæ articulis 3 glabris.

Tarsi maris articulis dilatatis subtus dense spongiosis.

Ligula paraglossis distinctis.

Subfam. 3. *Scaritini.*

Abdomen sexus utriusque 6-articulatum; epimera mesothoracis diagonaliter divisa: (parapleuræ sæpe non appendiculatæ, et tibiæ anticæ simplices.)

* Erichson (Käfer der Mark Brandenburg) says that the parapleuræ in this family are without any posterior appendage. I find this character very uncertain, as in some species (e. g. C. *purpurea*) the appendage, though small, is very distinct. In *Omus Californicus* there is hardly a trace of it, and in *O. Dejeanii* it cannot be seen at all.

E. *OZÆNÆ.*

Parapleuræ appendiculatæ.
Tibiæ anticæ emarginatæ, truncatæ.
Paraglossæ latissimæ, connatæ, distinctæ.
Antennæ sub frontis lateribus insertæ.

F. *BROSCI.*

Parapleuræ variæ.
Tibiæ anticæ truncatæ, emarginatæ.
Ligula dilatata, paraglossæ angustæ, rarius elongatæ.
Antennæ articulis 4 glabris.
(Maxillæ basi non spinosæ.)

G. *SCARITIDES.*

Parapleuræ variæ.
Tibiæ anticæ emarginatæ, palmatæ.
Paraglossæ distinctæ, apice liberæ.

H. *BEMBIDIA.*

Parapleuræ appendiculatæ.
Tibiæ anticæ emarginatæ, truncatæ.
Paraglossæ distinctæ apice liberæ.
Antennæ articulis 2 glabris.

I. *CARABI.*

Parapleuræ non appendiculatæ.
Tibiæ anticæ vix emarginatæ.
(Maxillæ præcipue basi spinosæ.)

A. *DRYPTÆ.*

a. *Galeritæ.*

Caput postice constrictum.
Elytra truncata.
Tibiæ anticæ tenues.
Antennæ articulo 1mo elongato.

b. *Helluones.*

Caput postice modice constrictum.
Elytra abbreviata, subtruncata.
Tibiæ anticæ compressæ dilatatæ.

c. *Moriones.*

Caput postice modice constrictum.
Elytra integra.
Tibiæ anticæ compressæ dilatatæ.

(c′. *Apotomi.*)
(c″. *Anthiæ.*)

d. *Panagæi.*

Caput postice sæpissime constrictum.
Elytra integra, punctis ocellatis nullis.
Tibiæ anticæ non dilatatæ.

B. *PTEROSTICHII.*

e. *Lachnophori.*

Caput postice constrictum.
Thorax pedunculatus.
Elytra vix truncata, stria 9na ambiente.
Palpi apice acuminati.
Tibiæ anticæ tenues, ungues simplices.
(Tarsi maris non dilatati.)

f. *Odacanthi.*

Caput rhomboideum, postice constrictum.
Thorax elongatus.
Elytra truncata, vel subtruncata.
Palpi labiales filiformes.
Tibiæ anticæ tenues; ungues varii.

g. *Lebiæ.*

Caput sæpe postice constrictum.
Elytra valde truncata.
Tibiæ antice tenues; ungues varii.

h. *Trechi.*

Caput postice non constrictum.
Elytra integra, stria 8va interrupta.
Tibiæ anticæ variæ; ungues simplices.
(Antennæ sæpe articulis basalibus subglabris.)

i. *Platyni.*

Caput postice non constrictum.
Elytra non truncata, stria 8va integra.
Tibiæ anticæ tenues, ungues varii.

k′. *Stenomorphi.*

(Mentum non dentatum.)

k′. I have slightly examined a South American species of Stenomorphus, without, however, being convinced that the genus should form a separate group. All the genera of (k) known to me have a tooth in the middle of the emargination of the mentum, and this appeared to be the only difference.

k. *Pterostichi* (genuini.)
Caput postice non constrictum.
Elytra integra, stria 8va integra.
Tibiæ anticæ apice incrassatæ et spinulosæ.
(Mentum medio dentatum.)
(Corpus glabrum.)

C. *HARPALI.*

l. *Harpali* (genuini.)
Abdomen non pedunculatum.

(l'. *Ditomi.*)

D. *CHLŒNII.*

m. *Licini.*
Labrum impressum.
Mentum non dentatum.
Elytra punctis ocellatis solitis.

n. *Chlœnii* (genuini.)
Labrum planum.
Mentum medio dentatum.
Elytra punctis ocellatis solitis.
(Corpus valde pubescens.)

o. *Oodides.*
Labrum planum.
Mentum medio dentatum.
Elytra punctis ocellatis margini contiguis.

E. *OZÆNÆ.*

p. *Pseudomorphi.*
Elytra truncata, margine non interrupto.

(p'. *Ozænæ.*)
(Elytra integra, sulco marginali interrupto.)

(p''. *Siagonæ?*)

F. *BROSCI.*

q. *Psydri.*
Tibiæ anticæ emarginatæ truncatæ.
Parapleuræ appendiculatæ.
Prosternum non productum.

r. *Metrii.*
Tibiæ anticæ emarginatæ, truncatæ.
Parapleuræ appendiculatæ.
Prosternum postice productum.

p'. I have had no opportunity of examining this group, but from figures and remarks by various authors I have no doubt of its near relationship with Ozæna.

r'. *Brosci* (genuini.)
(Parapleuræ appendiculatæ.
Prosternum postice non productum.
Thorax pedunculatus.)

s. *Promecognathi.*
Parapleuræ non appendiculatæ.
Tibiæ anticæ emarginatæ, truncatæ.
Prosternum non productum.
(Labrum breve, sinuatum.)

G. *SCARITIDES.*

t. *Scaritides* (genuini.)
Parapleuræ variæ.
Tibiæ anticæ emarginatæ palmatæ.
Antennæ articulo 1mo longissimo.

u. *Clivinæ.*
Parapleuræ appendiculatæ.
Tibiæ anticæ emarginatæ, palmatæ.
Antennæ articulo 1mo non longiore.

H. *BEMBIDIA.*

v. *Bembidia* (genuini.)
Parapleuræ appendiculatæ.
Tibiæ anticæ emarginatæ truncatæ.
Antennæ filiformes, articulis 2 glabris; 3io subglabro.
(Palpi sæpissime subulati.
Elytra stria marginali integra.)

I. *CARABI.*

x. *Carabi* (genuini.)
Tibiæ anticæ non emarginatæ.
Acetabula antica postice hiantia.
Mesosternum detectum.

y. *Elaphri.*
Tibiæ anticæ emarginatæ, vel simplices.
Acetabula antica integra.
Mesosternum detectum.

z. *Omophrones.*
Tibiæ anticæ vix emarginatæ.
Acetabula antica integra.
Mesosternum prosterno dilatato obtectum.

Subfam. 1. BRACHININI.

Abdomen of both sexes with seven segments.

This subfamily consists of a single group, composed of three genera, of which Brachinus alone is found within our territory. The species of these genera possess the singular power of emitting with great force a highly volatile and corrosive liquid, so as to produce a slight explosion. It is said that the genus Ozæna (group p'.) also possesses this power, but as Brachinus differs from all other Carabica in the number of abdominal segments, we must admit with great caution that any genus not agreeing with it in that respect, should have this explosive power: it is necessary that the phenomenon should be confirmed by the most careful observation, before it can be admitted. The statement formerly made by me of the explosive power of a species of Galerita is incorrect.

In this group the ligula is narrow, the paraglossæ broad, distinct, and connate with the ligula: the mentum has a basal membrane in the emargination, as in Lebia: the first three joints of the antennæ are smoother than the others, though not glabrous: the anterior tibiæ are almost filiform, emarginate internally: the epimera of the mesothorax are divided by a suture, which is almost diagonal, and much anterior to the position in which it is found in the second subfamily: the parapleuræ are distinctly appendiculate: the elytra are broadly truncate.

From this assemblage of characters this subfamily appears to be more closely allied to the Lebiæ than to any other group of the next subfamily.

Our species of Brachinus are similar to each other in form and colour, and differ by very slight characters. They are described at length in the Annals of the Lyceum of Natural History of New York, Vol. 4. Although willing to admit that the number of species there described is too great, yet, after repeated trials, I have failed to find any good characters by which to distinguish them, and I can therefore at present add nothing satisfactory on the subject.

Subfam. 2. HARPALINI.

Abdomen of both sexes with six segments: epimera of mesothorax not diagonally divided.

a. *Galeritæ.*

The characters of this group in its division, are sufficiently obvious in the diagnosis before given: the first four joints of the antennæ, though hairy, are less so than the following joints: the first joint is much the longest.

Our genera may be thus arranged.

A. Caput collo tenui thoraci junctum:

Antennæ setaceæ - - - - - - - - - - - - -	Galerita *Fabr.*
Antennæ filiformes, articulis 3^io^ 4^to^que sequentibus æqualibus - - -	Zuphium *Latr.*

B. Caput collo crassiore thoraci iunctum:

Antennæ filiformes, articulo 3^io^ 4to breviore, et 2^ndo^ æquali; thorax basi truncatus,	Diaphorus *Dej.*
Antennæ variæ, articulis 2—4 æqualibus; thorax basi sub-pedunculatus, -	Thalpius *Lec.*

Thalpius is very closely allied to Diaphorus, and forms the transition from this to the next group: the anterior tibiæ, though thicker than in Galerita, are not compressed and dilated as in Helluomorpha; the terminal spurs are obsolete. The first joint of the antennæ is as long as the three following; the succeeding joints are equal in size, and vary in form in the different species: in the type T. p y g m æ u s, they are almost square, with rounded angles, so that the antennæ become moniliform. The palpi are as in Diaphorus, the maxillary dilated, the labial small and filiform: the mentum tooth is broad and indistinct: the first joint of the posterior tarsi is as long as the three following. The body is elongated, and the sides of the elytra are parallel.

The genus Enaphorus *Lec.* (Ann. Lyc. 5, 173,) founded on a Californian species E. r u f u l u s, must be suppressed, as it differs from Thalpius only in the form of the antennæ, which are more filiform, and less compressed.

The type of Thalpius is T. p y g m æ u s *Lec.* (Ann. Lyc. 5, 173,) which is Helluo pygmæus *Dej.* (Sp. Gen. 2, 460.) A nearly allied species was given me by Mr. Guex, as coming from Louisiana, which may be Diaphorus dorsalis *Brullé*, as from my friend Dr. Schaum, I learn that that species is very closely allied to the one just mentioned. The three species may be thus defined:—

1. T. p y g m æ u s, elongatus, valde punctatus, fuscus, pubescens, elytris convexiusculis, cribrato-striatis, interstitiis uniseriatim punctatis, basi late obsolete rufa; pedibus palpis antennisque flavis, his brevioribus articulis fere rotundatis. Long. ·2.

2. T. d o r s a l i s, elongatus, rufo-testaceus, valde punctatus, pubescens, elytris planiusculis, cribrato-striatis, interstitiis uniseriatim punctatis, macula communi postica infuscata, pedibus pallidis, antennis capite thoraceque longioribus, articulis oblongis. Long. ·2.

3. T. r u f u l u s, depressus, rufo-testaceus, valde punctatus, pubescens, elytris planis, subtilius striatis, interstitiis confuse punctatis, antennis capite thoraceque longioribus, articulis oblongis. Variat sutura postice infuscata. Long. ·22.

b. *Helluones.*

This group differs from the preceding, principally by the broader anterior tibiæ, and shorter first joint of antennæ: the elytra are shorter than the abdomen, but broadly rounded at the extremity. The affinity between this group and the Anthiæ has been already observed by Chaudoir. (Bull. Mosc. 1850.)

The only genus found in the United States is Helluomorpha *Lap.*, with the labrum large, concealing the mandibles, and the antennæ strongly compressed and thickened externally. The four described species are very uniform in appearance, and apart from size and colour may be best distinguished by the proportions of the joints of the antennæ. The anterior tarsi of the males are scarcely dilated. The two following species are new.

1. H. f e r r u g i n e a, depressa, obscure ferruginea, capite thoraceque valde punctatis, hoc lateribus antice rotundatis, postice subsinuatis, basi perparum angustato, angulis posticis obtusis, elytris thorace latioribus, sulcis minus profundis confuse punctatis, interstitiis vix parce punctatis, antennis capite thoraceque longioribus, articulo 4to vix dilatato, sequentibus non transversis. Long. ·6.

Texas; Lieut. Haldeman and Mr. Lindheimer. Except by the form of the antennæ, this species almost exactly resembles H. praeusta and laticornis; the thorax is, however, less narrowed posteriorly.

2. H. texana, piceo-ferruginea, depressa, caput thoraceque valde punctatis, hoc lateribus antice rotundatis, postice angustato et lateribus sinuato, angulis posticis obtusis, elytris thorace latioribus, sulcis minus profundis biseriatim punctatis, interstitiis lævibus, antennarum articulo 4to triangulari, sequentibus quadratis vix transversis. Long ·7.

One specimen, Texas; Lieut. Haldeman. By its general form and structure of the antennæ this species resembles strongly H. praeusta, but the grooves of the elytra have each two regular series of punctures, while in all our other species the punctures are confused.

c. *Moriones.*

A group of very difficult location, as it shows very strong resemblance to the Pterostichi and Harpali in its external form: from the form of the anterior tibiæ, and the antennæ, and from the absence of paraglossæ, and the dilatation of the ligula, its true affinities appear to be with the Helluones, from which it differs chiefly in having the elytra as long as the abdomen. In the only species of the group found in our country M. monilicornis, the antennæ are less broad and less hairy than in Helluomorpha, the first four joints are shining, with only a few hairs at their extremity; the following joints are broader, nearly square, glabrous on their flat sides, pubescent near the edges. The anterior tibiæ are compressed and dilated, the external angle is slightly produced: the tarsi are short and compressed, those of the male are not dilated. The series of punctures adjacent to the 8th stria of the elytra is distinct, and the 9th stria posteriorly diverges from the margin.

This last character, with the slight posterior constriction of the head, serves well to distinguish this group from any Pterostichi or Harpali to which it may be supposed to be allied.

Morio pygmæus *Dej.* is no Morio. I have formed of it the genus Haplochile, which will be found in group (q.)

d. *Panagæi.*

A great innovation is here proposed, by associating the Panagæi in close relationship with the Anthiæ. Yet on examination, I have failed to discover any reason for associating them with Chlœnius, as most authors have done, or with Loricera and Badister as Erichson has proposed.

The group *Licinini* of Erichson seems to me so completely artificial that I have discarded it. By his definition it differs from *Chlœniini* only in having the paraglossæ connate with the ligula, while in the form and proportions of these same organs we find great differences. By this means we have Badister and Licinus widely separated from Dicælus, and associated with Panagæus and Loricera, which seem to have as little affinity with each other as with any of the genera above mentioned. The last genus by its structure and habits belongs to the Elaphri, in the neighbourhood of Blethisa.

It would be rash to attempt to fix the characters of the present group definitely without

a careful examination of the foreign species, some of which seem by description to indicate a relation towards Cychrus. Ferté has separated under the name Isotarsus certain species in which the anterior tarsi of the males are not dilated, but without indicating any other characters by which they can be distinguished. The form of the head, heretofore considered sufficient to separate Panagæi from the other sections of "Patellimanes," has ceased to be diagnostic by the discovery of Eugnathus, below described.

The detail of the following characters, common to our two genera, may aid future investigation in endeavouring to fix the characters of the group.

The third joint of the antennæ is not glabrous, though a little smoother than the fourth. The mentum is smaller than usual, narrowed in front, and less deeply emarginate, with a tooth in the middle of the emargination; the ligula is corneous, apparently truncate, without distinct paraglossæ; the palpi are long and more or less dilated according to species; the thorax is constricted at base, and the abdomen almost pedunculated; the posterior appendage of the parapleuræ is very indistinct, the anterior tibiæ are emarginate as usual, scarcely thickened at the extremity: the dilatation of the anterior tarsi of the male is confined to the first two joints, which are spongy beneath. The body above and beneath is strongly pilose and punctured; the striæ of the elytra are normal in position, but the series of ocellate punctures near the 8th stria is not visible. Our genera are as follows:—

Caput postice constrictum, mandibulæ breves acutæ -	Panagæus *Latr.*
Caput postice non constrictum, mandibulæ crassæ dilatatæ	Eugnathus *Lec.*

Of Panagæus we have two species; P. c r u c i g e r u s *Say*, and P. f a s c i a t u s *Say*. Trans. Am. Phil. Soc. 2, 69.

EUGNATHUS *Lec.*

Caput obtusum, postice non constrictum; mandibulæ crassæ, dilatatæ, supra concavæ apice deflexæ, obtusæ; labrum parvum, inter mandibulas supra situm, transversum, antice rotundatum; palpi longiusculi, articulo ultimo ovali truncato; thorax postice sensim valde angustatus sub-pedunculatus, abdomen pedunculatum, a thorace remotum.

The other characters as in Panagæus; the male is unknown, the only species of the genus is Panagæus distinctus *Hald.* (Stansbury's Exped. 373) for the typical specimen of which I am indebted to my friend S. S. Haldeman. It was found near Sta. Fe, New Mexico, and may be thus defined:—

E. d i s t i n c t u s, rubens, flavo-pilosus, capite, thoraceque grosse punctatis, hoc transverso, obovato, postice valde angustato, lateribus valde rotundatis, elytris dorso subdepressis, striis valde cribratis, macula transversa nigra utrinque ad medium ornatis, apice summa, pedibus, ore antennisque piceis, his articulo 1mo rufo. Long. ·3.

c. *Lachnophori.**

On account of the acuminate palpi, these little insects have usually been associated with Bembidium, and in describing the genus Ega, Laporte, with his accustomed quickness of

* Only two genera, Lachnophorus and Ega are found in the United States, two species of each genus are, however, one on each side of the continent.

The species of this group are found running on wet mud, usually in grassy places, and are abundant in those localities. The anterior tarsi of the males are not dilated.

observation, has stated the last joint to be small and subulate: had he taken the trouble to observe the number of joints preceding his last joint, he would have seen that the latter was no joint at all, but merely the obliquely pointed apex. Chaudoir seems to have been the first to separate them into a distinct group, without, however, pointing out the precise characters by which they may be distinguished, and without any remarks upon their affinities, which are, indeed, extremely obscure; Solier has placed them near Casnoniæ. To the insects of the preceding division they have but little resemblance, although there is a slight analogy to be found in Diaphorus, not only in the form of the head and thorax, but also in the extension of the 9th stria of the elytra around the apex, so as to meet the sutural stria. The paraglossæ are linear, and much longer than the ligula.

f. *Odacanthæ.*

This is the first of the numerous groups of this division, the principal common character of which seems to be that the three basal joints of the antennæ are evidently of a different nature from the others, more polished, and usually entirely glabrous. The chief exceptions to this last character are found in the present group, where, in some of the genera, the antennæ are hairy even to the base, but by close inspection the difference in appearance between the 3d and 4th joint can always be recognised. In this series, this group is readily known by the large rhomboidal head inserted into the thorax by a small neck, and by the long and cylindrical thorax. The form of the elytra is variable, but they are always truncate to some extent: the anterior tibiæ are slender, and not spinous at the tip; their spurs appear distinct: the tarsi are sometimes broad, sometimes narrow, their fourth joint is more or less emarginate: the claws are variable in form.

Five species are cited as inhabiting the United States: Casnonia Pensylvanica and Leptotrachelus dorsalis, are the only ones known to me: the others are C. p i c t a *Chaud.*, Bull. Mosc., 1848, C. l u d o v i c i a n a *Sallé,* Ann. Ent. Soc. Fr. 1849, and C. r u f i p e s *Dej.* The last is placed by Chaudoir in his genus Apiodera.

g. *Lebiæ.*

A very extensive group, comprising the greater part of the "Truncatipennes" of Dejean, and consisting of insects, which, though somewhat differing in form, are related by very strong joints of resemblance, and connected by insensible modifications of structure. The elytra are always truncate at the extremity, and the anterior tibiæ are slender and scarcely spinous at the extremity: their terminal spurs are sometimes distinct, sometimes obsolete. The first three joints of the antennæ appear to be always very smooth and glabrous. The head, tarsi, and ungues are variable in form, even among closely allied genera. The anterior tarsi of the male are slightly dilated, and furnished beneath with series of papillæ. The maxillary palpi are always filiform.

For the more convenient analysis of the genera, we may divide the group into three tolerably well defined portions.

Mentum dente medio indistincto, membrana basali velato.

1. Caput postice constrictum; palpi labiales non dilatati.
2. Caput postice vix constrictum; palpi præcipue acuminati.

3. Mentum dente magno, distincto: palpi maxillares semper truncati: labiales dilatati: caput postice vix constrictum.

The first division contains species living mostly on plants: the strongly constricted head sufficiently distinguishes them at first sight: the basal membrane of the ligula is thickened so as to fill up the emargination of the mentum, so that it becomes very difficult to determine if a tooth be really present: the maxillary palpi are cylindrical in our genera, and very slightly truncate at tip. They are thus related:—

Tarsi dilatati, subtus spongiosi: thorax basi truncatus - - -	Plochionus *Dej.*
Tarsi dilatati, subtus spongiosi: thorax pedunculatus - - -	Lebia *Latr.*
Tarsi filiformes, thorax pedunculatus - - - - - -	Didetus *Lec.*
Tarsi filiformes, thorax postice dilatatus, truncatus - - -	Nemotarsus *Lec.*

In two of our species of Lebia (g r a n d i s and a t r i v e n t r i s,) the first three joints of the anterior tarsi of the male are obliquely dilated, as in Galerita: after a very careful examination, I can find no character of sufficient importance to separate them as a distinct genus: the mentum tooth appears somewhat larger and more prominent, but this is a deceptive character in the present group.

Didetus *Lec.*

Caput pone oculos rotundatum, basi constrictum, collo tenui cylindrico: labrum amplum, antice rotundatum, mandibulas fere obtegens; palpi maxillares labialibus sesqui longiores, articulo ultimo præcedente fere duplo longiore, leviter ovali, acuminato: antennæ filiformes, articulis subæqualibus, 2^ndo^ paulo breviore, 1-3 glaberrimis, 4to modice pubescente. Thorax brevis, cordatus, postice maxime angustatus, basi brevissime tubulatim pedunculatus; elytra apice truncata. Pedes tenues elongati, tibiæ calcaribus obsoletis, ungues simplicissimi, tarsi postici articulis duobus primis elongatis.

This genus is evidently related to Lionychus, but differs in not having the anterior margin of the clypeus elevated, and in having the head strongly constricted posteriorly. The mentum-tooth of Lionychus is said to be distinct; in this genus, the middle portion of the basal membrane, filling the emargination, is corneous, but less so than the mentum itself, so that in certain positions the mentum appears to have a large obtuse tooth, united by a suture, and in other positions to be without a tooth. But one species is known to me.

D. f l a v i p e s, picco-niger, nitidus, thorace latitudine sesqui breviore, postice valde angustato, antico latissimo et lateribus subangulato, margine reflexo picescente, elytris duplo latioribus, obsolete striatis, pedibus flavo-testaceis. Long. ·17.

Louisiana, Mr. Guex. The antennæ are entirely black, the palpi piceous, the ligula and adjoining parts pale.

Nemotarsus *Lec.*

Caput pone oculos rotundatum et valde constrictum, collo tenui cylindrico; labrum quadratum, os angustum: palpi maxillares labialibus duplo longiores, articulo ultimo præcedente duplo longiore, conico, acuminato, labiales articulo ultimo leviter ovali, acuto: mentum dente magno indistincto: antennæ filiformes, articulis æqualibus, 2^ndo^ sesqui breviore. Thorax semicircularis, basi truncatus: elytra truncata. Pedes tenues, elongati, tibiæ calcaribus elongatis, ungues fortiter pectinati, tarsi filiformes, postici articulis 1-4 gradatim brevioribus.

In form, this little insect exactly resembles Plochionus, but the head is more suddenly constricted behind: the strong spurs of the tibiæ approximate it more nearly to Tetragonoderus: the ligula is precisely as in Lebia, that is, with the paraglossæ entirely connate: the mentum as in Lebia, with a large indistinct tooth. The only species known to me is:—

N. elegans, flavo-testaceus, elytris profunde striatis, interstitiis convexis, atris margine tenui laterali, apice late, maculaque utrinque magna antica usque ad medium extensa flavis. Long. ·18.

One specimen from Illinois, Mr. Willcox; a second found by me in Upper Georgia: the elytra are marked very much as in Lebia axillaris *Dej.*; the anterior spot extends from the middle nearly to the base; its outer margin is parallel with the side of the elytron; its inner margin is rounded.

The second division of this group consists of insects which live in the ground under stones and leaves, but occasionally are found under bark of dead trees: one genus alone (Coptodera,) is said to occur on plants.

These insects differ from the preceding genera, in having the head but slightly constricted behind the eyes, and by no means furnished with a distinct neck: the mentum has a membrane filling up the emargination, so that the tooth is more or less indistinct: the palpi are flattened at tip, or acuminate, so that in one direction their apex appears sharp. Owing to the indistinctness of the characters derived from the mouth, and the variable form of the ungues of the tarsi in closely allied species, the genera of this group are in a moderate state of confusion. In all of our genera, the tarsi are entirely filiform: the ligula is variable in form, some of the genera having connate paraglossæ, others having them free at the apex.

Palpi labiales cylindrici.	
Tibiæ intermediæ spinulosæ, thorax basi truncatus - -	Tetragonoderus *Dej.*
Tibiæ intermediæ non spinulosæ, thorax basi truncatus.	
Mentum dentatum, ungues pectinati - - -	Coptodera *Dej.*
Mentum non dentatum, ungues pectinati - -	Dromius *Bon.*
Mentum vix dentatum, ungues simplicissimi - -	Apristus *Chaud.*
Thorax basi lobatus, ungues subserrati - - - -	Metabletus *Schmidt.*
Palpi labiales crassi, ungues plus minusve serrati - -	Axinopalpus *Lec.*

Coptodera and Dromius come very near together, so much so that I have been unable to find any distinct character to separate them: besides the slight and uncertain character in the mentum, the palpi of Dromius appear to be thicker, and the spurs of the tibiæ less developed.

Tetragonoderus contains two native species: T. intersectus *Lec.* (*Lecontei* Dej.: *Bembidium intersectum* Germ. Ins. Nov. 28,) and T. fasciatus Lec.; (*Coptodera fasc.* Hald. Proc. Acad. Nat. Sc. 1, 298: *Thyreopterus fasc.* Lec. Ann. Lyc. 4, 197.)

The differences between the American species of Axinopalpus, Apristus, and Metable-

tus* have been already pointed out by me. My genus Bomius must be united with Metabletus, the ungues being either simple or slightly serrate; the genus Blechrus *Motsch.* which I considered as perhaps identical with Bomius, is not adopted by Chaudoir, on account of the falseness of the characters given: Chaudoir says that the typical species has dentate ungues, and must therefore be placed in Metabletus: it is probable that the form of the ungues is not to be considered as of generic value, as we have differences in species that are certainly closely allied. The same variations are to be found in Axinopalpus.

The third division of the group consists of species of a larger size, living under stones or under bark, and distinguished by the mentum tooth being large and distinct, not obscured by a basal membrane: the paraglossæ are always connate with the ligula: the labial palpi are more or less dilated and truncate; the maxillary palpi are always cylindrical, and truncate, never acuminate: the fourth joint of the tarsi is triangular and more or less emarginate. Our genera are the following:—

A. Ungues dentati.	
Thorax basi lobatus; palpi labiales crassi - - - - -	Apenes *Lec.*
Thorax basi truncatus; palpi labiales crassi - - - -	Glycia *Chaud.*
Thorax basi truncatus, palpi labiales mediocres: tarsi art. 4to bilobo -	Calleida *Dej.*
Thorax basi truncatus, palpi labiales mediocres: tarsi art. 4to triangulari	Cymindis *Latr.*
B. Ungues non dentati: thorax basi truncatus - - - -	Philoteenus *Lec.*

The characters of these genera have been sufficiently detailed by me in the fifth volume of the Annals of the Lyceum. It is merely necessary to state at present that to Glycia belong Cymindis purpurea *Say.* Trans. Am. Phil. Soc. 2, 9, and C. viridicollis *Lec.* Ann. Lyc. 4, 188. C. amœna *Lec.* is only a green variety of C. purpurea.

Philoteenus ruficollis *Lec.* Ann. Lyc. 5, 175, is evidently Calleida croceicollis *Menet.* Bull. Soc. Petrop. 2, 53. The last-mentioned specific name has, of course, priority.

h. *Trechi.*

A group composed of small species, easily distinguished from all other Carabica, by the 8th stria of the elytra being broadly interrupted or obsolete: the sutural stria is frequently recurved at the apex. The last joint of the palpi is acuminate, and in some species is smaller than the penultimate, and subulate: this form of palpi, as we will afterwards find, occurs again in the Bembidia, which are distinguished from Trechi, not only by the deep and entire 8th stria, but by the diagonal suture of the epimera of the mesothorax.

The ligula is free at the apex and truncate: the males have two joints of the anterior tarsi obliquely dilated, and papillose beneath, but in Anophthalmus scarcely any dilatation can be perceived. The anterior tibia are variable in form, being linear and emarginate below the middle in Anophthalmus, while in Epaphius and Tachys they are somewhat dilated and emarginate as far as the middle. These insects have the basal joints of the antennæ sometimes hairy, and thus approach the Harpali in Stenolophus and still more nearly in Eucærus.

* Ann. Lyc. 5, 177.

i. *Platyni.*

In this group the anterior tibiæ are linear, or very slightly dilated, and scarcely spinous at tip: the three first joints of the antennæ are entirely glabrous: the ligula is free at the extremity, and the paraglossæ distinct. The elytra are sinuate, or rounded at the tip, never truncate: the ungues are either pectinate, obsoletely serrate, or simple: the anterior tarsi of the males have three joints slightly dilated, and papillose beneath. Except by sexual characters, it is difficult to separate this group from Pterostichi and Chlœnii: the body is, however, never densely pubescent as in the latter. This group also evidently osculates with Patrobus, among the Bembidia, the epimeral suture in some species being somewhat oblique.

Of the genera contained in it, I will merely observe that they seem to have been unnecessarily multiplied on very slight characters, and yet without a careful comparison of foreign species, it is impossible to reduce them to order. I am inclined to believe that the form of the ungues has received more weight than it deserves, as in comparing three species of Pristodactyla, I find that while one has the ungues strongly pectinate, and another has them almost smooth, the third is exactly intermediate, having them slightly but distinctly toothed. Sericoda *Kirby* (Rhytiderus *Chaud.*) belongs in this group, but there appears to be no reason for separating it from Platynus. The species of the lastnamed genus are so numerous and closely allied that it would be useless to describe the new species, except in a synopsis.

k. *Pterostichi.*

These are insects with the anterior tibiæ somewhat thickened towards the tip, and armed with short spines: the antennæ have three joints entirely glabrous: the tarsi are cylindrical; the anterior ones of the male have three joints dilated, triangular or obcordate, with a double series of papillæ beneath. The European genus Broscus, usually associated with these, must be removed to the neighbourhood of Scarites, on account of the form of the epimera of the mesothorax, and the different brush-like dilatation of the anterior tarsi of the male.

Of the genera allied to Pterostichus, I have given a synopsis in the Journ. Acad. Nat. Sci. (New Ser. 2, 225.) All the other native species must be merged into Amara, with the exception of two species belonging to the genus Myas, which is sufficiently distinct by the dilated form of the palpi.

The mentum in all the genera known to me is strongly toothed; this character, added to the flat labrum, enables this group to be distinguished from the Licini. The systematic separation from Chœlnii, however, appears to be purely sexual. The pubescence of the upper surface enables the latter to be distinguished at first sight.

Our genera of the present group are then: Evarthrus *Lec.;* Pterostichus *Bon.;* Lophoglossus *Lec.;* Holciophorus *Lec.;* Loxandrus *Lec.;* Poecilus *Bon.;* Myas *Dej.;* Amara *Bon.*

l. *Harpali.*

This group contains a large number of genera closely related to each other, and scarcely to be distinguished except by sexual characters, which are here very variable. They may

be distinguished from Pterostichi by the third joint of the antennæ being rough and pubescent, at least at its apex. The anterior tibiæ are more or less incrassated at tip, and usually slightly spinous: the thorax is truncate posteriorly, never pedunculated: the elytra are rounded, at tip or sinuate, and rarely truncate: the marginal stria is always normal in its position. When the anterior tarsi of the males are dilated, the intermediate tarsi usually show a similar structure.

It is probable that in this group, as in the Platyni, the judicious study of more extensive material than is afforded by one country will greatly diminish the number of genera. The most important generic character seems to be found in the form of the ligula, which is free at the apex, sometimes dilated, sometimes narrow: the paraglossæ are distinct, sometimes narrow, sometimes broad. Our genera may be divided into three groups.

a. Tarsi maris anteriores non dilatati, (pedibus subfossoriis.)
b. Tarsi maris anteriores dilatati, subtus spongiosi.
c. Tarsi maris anteriores præcipue dilatati, subtus biseriatim papillosi.

The first division contains Daptus and allied genera: the head is usually larger behind the eyes, than in the other two divisions; the anterior tibiæ are more dilated and more spinous, and the third joint of the antennæ is less pubescent. Besides these indications, I can give no characters which will enable the genera placed here to be distinguished from those which follow. The table of relations is:

Tibiæ anticæ extus subdentatæ - - - -	Nothopus *Lec.*
Tibiæ omnes apice expansæ - - - - -	Geopinus *Lec.*
Tibiæ simplices, mentum dentatum - - - -	Cratacanthus *Dej.*
Tibiæ simplices, mentum non dentatum.	
Labrum emarginatum, tarsi postici articulis 4 æqualibus	Cratognathus *Dej.*
Labrum non emarginatum, tarsi postici articulis 4 æqualibus	Agonoderus *Dej.*
Labrum non emarginatum, tarsi postici art. 4 gradatim brevioribus	Discoderus *Zim.*

Nothopus was formerly described by me (Ann. Lyc. 4, 151) as Euryderus, which name is preoccupied by Laporte's Eurydera. Geopinus contains only *Daptus incrassatus* Dej. My former genus Piosoma (Ann. Lyc. 4, 371.) seems so closely allied to Cratognathus, that I have merged them together. Besides C. s e t o s u s (the type of my genus) I have another species from New Mexico, which, by the absence of setigerous punctures, resembles the South American species. I have named it:

C. c o r d a t u s, piceus, thorace subcordato, postice angustato, et lateribus sinuato, angulis posticis rectis, basi utrinque breviter impresso, elytris striatis interstitiis planis, 5us, 7^mus^ que postice punctis paucis impressis, antennis pedibusque ferrugineis. Long. .3.

Of Agonoderus, I have to observe, that A. suturalis *Lec.* (Ann. Lyc. 4, 373) is a distorted specimen of A. i n f u s c a t u s *Dej.*

Discoderus *Zim.*

This genus was proposed to me by my friend Dr. Zimmermann, and contains two species; Selenophorus parallelus *Hald.* (Proc. Acad. Vat. Sc. 1, 302) and S. tenebrosus *Lec.*

(Ann. Lyc. 4, 391.) The anterior tarsi of the males are not dilated: the intermediate tibiæ of that sex are bent inwards, and strongly serrate internally. Besides these sexual characters, there is nothing to distinguish this genus from Selenophorus, except the greater breadth of the anterior tibiæ: the ligula as in Selenophorus is narrow, the paraglossæ broad and rounded: the 2d, 5th and 7th striæ of the elytra are marked with distant punctures: the two species are very closely related, and may be distinguished as follows:

1. D. parallelus, elongato-ovalis, cyaneo-niger, thorace latitudine subbreviore, lateribus rotundatis, angulis omnibus rotundatis, posticis leviter explanatis, elytris profunde striatis, triseriatim punctatis, antennis rufis, tibiis tarsisque rufo-piceis. Long. ·29.

Georgia, Pennsylvania, Missouri Territory.

2. D. tenebrosus, subelongatus, ovalis, subconvexus, niger, thorace latitudine breviore, lateribus magis rotundatis, angulis omnibus rotundatis, posticis obsolete explanatis, elytris profunde striatis, antennis rufis, tibiis tarsisque posticis rufo-piceis. Long. ·26.

Missouri Territory, near the Rocky Mountains.

The second division is named Eurytrichini in my catalogue of Geodephagous Coleoptera. It consists of genera in which four joints of the anterior and middle tarsi of the male are strongly dilated, and furnished beneath with a dense brush of hairs, as in Chlœnius; the fourth joint is strongly emarginate, or bilobed. Except by this sexual character, this division cannot be recognised, although the form of the ligula and paraglossæ will be sufficient to separate the genera from those of the next division. The terminal spur of the anterior tibiæ is subject to great variation in form in the genus Anisodactylus; it is double in the European genus Diachromus, but single in all the rest. Dichirus *Man.* was described as having a double spur, but after a very close examination, I can find no sufficient reason for separating it from Anisodactylus, the original observations on the form of the spur being erroneous.

Our genera may be thus arranged.

Ligula apice dilatata, paraglossis angustis, longioribus; mentum edentatum	Anisodactylus *Dej.*
Ligula apice non dilatata, truncata, vel subtruncata:	
Paraglossæ angustæ curvatæ, ligulæ æquales:	
Mentum medio edentatum - - - -	Xestonotus *Lec.*
Mentum medio dentatum - - - -	Spongopus *Lec.*
Paraglossæ latæ, rotundatæ, ligula longiores:	
Mentum medio edentatum - - . -	Amphasia *Newm.*
Mentum medio dentatum - - - -	Eurytrichus *Lec.*

With Anisodactylus, as above mentioned, I have found it necessary to unite Dichirus *Man.* which has the spur of the anterior tibiæ, not double, but only trifid, as in many of our common species; (A, merula, nigrita, luctuosus, &c.)

I have found it necessary to place in the same genus Harpalus femoratus *Dej.* I formerly considered it as belonging to Amphasia, but the ligula is as in the other species

of Anisodactylus, although the paraglossæ are not so much elongated. Our numerous species may be grouped as follows.

a. Corpus pubescens, elytris interstitiis biseriatim punctatis: tibiæ anticæ calcare terminali utrinque acute dentato. (A. dilatatus, brunneus, parallelus, obtusus, cum speciebus aliis sub Dichiro inscriptis.)

b. Corpus glabrum, ellipticum vel oblongum, tibiis anticis calcare terminali utrinque acute dentato. (A. merula, carbonarius, &c.)

c. Corpus glabrum, tibiis anticis calcare terminali basi latiore, non dentato. (A. nigerrimus, nigrita, californicus, cænus, &c.)

d. Corpus pubescens, tibiis anticis calcare terminali simplici. (A. femoratus.)

The first group recedes from the others in the intermediate tarsi of the male being sometimes scarcely dilated: the 2d and 3d joints of the anterior tarsi are strongly transverse, and the 4th not deeply bilobed; there are, however, some species of group (c) in which the middle tarsi are much less dilated than the anterior pair, while the species of group (b) have the 2d and 3d joints of the anterior tarsi as strongly transverse as those of Dichirus. We would not, therefore, be justified in considering the latter as a distinct genus.

Spongopus still contains only the typical species S. v e r t i c a l i s *Lec.* (Ann. Lyc. 4, 378,) it seems closely allied to Diachromus *Er.*, but differs in having only a single long and slender spur at the end of the anterior tibiæ.

Xestonotus *Lec.*

This genus is established upon Selenophorus lugubris *Dej.*, which, from the form of the anterior tarsi of the male, I formerly placed in Anisodactylus: the ligula however differs essentially from that genus; it is truncate at tip, and not dilated, furnished with two long bristles: the paraglossæ are slender and curved, not extending beyond the ligula: the emargination of the chin is rounded. The anterior and middle tarsi of the male have the first joint slightly dilated, the two next broader and transverse, the fourth broad and deeply bilobed: the spur of the anterior tibiæ is simple, and moderately slender. The diagnosis of the species will be:

X. l u g u b r i s, oblongus, niger, opacus, capite maiusculo, thorace latitudine sesqui breviore antice valde emarginato, angulis posticis obtusis, ad basin utrinque late leviter impresso, et obsolete punctulato, elytris interstitiis vix convexis, 3^tio^ postice unipunctato, antennarum articulo 1mo palporumque apice rufis. Long. .4.

Eurytrichus *Lec.*

This genus has been described at length by me in the 4th volume of the Annals of the Lyceum: it contains Feronia t e r m i n a l i s *Say*, (of which Harpalus testaceus *Hald.* Proc. Ac. Nat.Sc. 1, 302, is a variety;) Harp. a g i l i s *Dej.*; E. p i c e u s *Lec.*; E. n i t i d i p e n n i s *Lec.*,* and a large species from Louisiana, sent by Messrs. Wapler and Sallé, under the name Harp. dulcicollis *Ferté* (Rev. Zool. 1841,) with the description of which it by no means

* H. dichrous Dej. and H. vulpeculus *Say*, do not belong to Eurytrichus, as I formerly supposed, but to Bradycellus.

agrees. I am inclined to believe that it may be Harp. maculicornis *Chaud.* (Bull. Mosc, 1843:) it is nearly of the size of H. bicolor, and may be distinguished as follows:

E. maculicornis, oblongus, niger nitidus, thorace latitudine sesqui breviore, antrorsum subangustato, lateribus modice rotundatis, postice late subdepressis, angulis posticis obtusis, basi utrinque leviter impresso, elytris striatis, interstitiis vix convexis, 3^io^ postice unipunctato, palpis antennisque rufis, his articulis 2-6 plus minusve nigricantibus. Long. ·58.

It is quite possible that future investigation may show the necessity of uniting Eurytrichus with Anisotarsus *Chaud.* (Bull. Mosc. 1837,) but as we already have two genera, Spongopus and Eurytrichus, differing from Anisodactylus by having a mentum-tooth, it will be necessary to know the form of the ligula of the typical species, A. brevicollis, before we can unite either of the genera with Anisotarsus.

In the third division of the Harpali the dilated joints of the tarsi of the male are not brush-like, but are furnished beneath with two series of feathery papillæ; in some of the species the first joint of the anterior tarsi of the female is large and dilated: it is doubtful if so much stress should be laid upon this character as has been done in the case of the Texan genus Gynandrotarsus *Ferté*, the male of which, according to the author, is a genuine Harpalus.

Some of the species of Stenolophus have the male tarsi scarcely dilated, thereby approaching the genera of the first division of the group, but they are easily distinguished by their more slender legs, and narrower anterior tibiæ.

The form of the ligula appears to be of fundamental importance in separating our closely allied genera.

A. Ligula angusta, fere linearis, paraglossis planis paulo longioribus.
  Mentum edentatum, tarsi antici articulo 1mo longiore - Gynandropus *Dej.*
  Mentum edentatum, tarsi antici articulis 1-4 æqualibus - Selenophorus *Dej.*

B. Ligula apice truncata, libera, paraglossis æqualis.
  Ligula apice dilatata, paraglossis planis, mentum edentatum Pangus.
  Ligula vix dilatata, paraglossis inflatis, mentum plus minusve dentatum Harpalus *Latr.*

C. Ligula apice truncata, libera, paraglossis brevior.
  Mentum valde dentatum, labrum truncatum - - - Bradycellus *Er.*
  Mentum non dentatum:
    Antennæ filiformes; elytra apice rotundata - - Stenolophus *Dej.*
    Antennæ moniliatæ, extus incrassatæ - - - Trechicus *Zim.*
    Antennæ filiformes; elytra apice truncata - - Eucærus *Lec.*

Gyandrotarsus does not appear in the tables, as I have never seen the insect, and the description by Ferté (Ann. Ent. Soc. Fr. x. 201,) ignores the ligula altogether: the mentum is said to be longer than usual, concave, squarely emarginate, and without a tooth. In his figure the ligula is represented as dilated with narrow paraglossæ, and the spur of the anterior tibiæ as lobed. As far as can be ascertained by comparing the descriptions, G. harpaloides is identical with Harpalus similis *Say*, (Trans. Am. Phil. Soc. 2, 29.) Say's species was found abundantly in North Carolina; Ferté's came from Texas.

Pangus seems distinct both from Selenophorus and Harpalus, by the form of the ligula and paraglossæ: the former is broad, dilated and truncate at the extremity; the paraglossæ are broad, rounded and flat, not extending beyond the ligula; the mentum is not at all toothed in P. caliginosus and P. testaceus, and very obsoletely toothed in Harpalus fraternus Lec. (Ann. Lyc. 5, 185,) which must be placed in this genus. I cannot find any description of this genus in the books; it was proposed in manuscript by Ziegler, many years ago, but as he apparently had no rational motive for founding it, or at least expressed none in any tangible form, systematic authors seem to have abandoned it as untenable: for this reason I have placed no authority after the genus in the synoptic table. The diagnosis of the new species is:

P. testaceus, elongato-oblongus, rufo-testaceus, nitidus, thorace latitudine plus sesqui breviore, lateribus anguste fortiter depressis, subpunctatis, antice rotundatis, angulis posticis rectis, prominulis, ad basin utrinque breviter impresso, elytris apice vix sinuatis, striis obsolete punctatis, interstitiis subconvexis, 3io unipunctato. Long. ·45.

Two specimens, Illinois; Mr. Willcox: one of the specimens has no puncture on the third elytral space. The sharp posterior angles of the thorax will distinguish this from any American species of Harpalus.

Bradycellus *Er.*

This genus contains many closely allied species, some of which so closely resemble in appearance species of the next genus, that in every instance it is necessary to examine the mentum before deciding on the genus to which any particular species belongs: I have tried without success to find some empirical character to remove this difficulty.

Although recognising the difference between this genus and Stenolophus, I was led, in my Catalogue of Geodephagous Coleoptera, to consider it as Geobænus *Dej.*, which, however, as there remarked, appears, by its brush-like dilated tarsi, to belong to the preceding division of the group. The excellent work of Erichson* afterwards made known to me the real differences of the genera of this group. In this genus must be placed Harp. dichrous *Dej.* (*iricolor* Say;) H. vulpeculus *Say* (*nigripennis* Dej.) and H. obesulus *Lec.* (Ann. Lyc. 5, 185:) the first of these, from its general appearance, was formerly considered by me as a Eurytrichus, but the examination of a male specimen since obtained, and the careful study of the ligula, has shown its relation to the other species of this genus.

Stenolophus badiipennis *Hald.* (Proc. Ac. Nat. Sc. 1, 202) also belongs in this genus: in my Catalogue of Geod. Col. it is falsely placed as synonymous with Trechus rufierus *Kirby*, (Faun. Bor. Ann. 47,) which is unknown to me.

Acupalpus suturalis *Lec.* (Ann. Lyc. 4, 411,) also belongs here, but the name being preoccupied by a European species, it must be called B. nebulosus. My eleventh species of Geobænus, (G. neglectus,) having no mentum tooth, belongs to Stenolophus.

Stenolophus *Dej.*

Of this genus there are in my collection about twenty-nine species: several of these are

* Kafer der Mark Brandenburg.

yet undescribed, but as isolated descriptions would tend only still more to confuse this difficult genus, they must be made known at some future time in the form of a synopsis. Our species form four groups:

1. The first contains those species which have the posterior angles of the thorax rounded, and the anterior and middle tarsi of the male broadly dilated, the fourth joint being deeply bilobed: the described species are, carbonarius *Brullé*, (*Harpalus carb.* Dej.;) spretus *Dej.;* fuliginosus *Dej.* (*versicolor* Kirby, and *fuscipennis* Lec.;) plebeius *Dej.;* fuscatus *Dej.* and coniunctus *Lec.* (*Trechus coniunctus* Say, *Acupalpus misellus* Dej.; *Ac. rotundicollis* et *lugubris* Hald.)

2. In this group the posterior angles of the thorax are rectangular and prominent; the tarsi of the male as in the first group; the alternate spaces of the elytra are marked with indistinct series of punctures: only one species belongs here, S. alternans *Lec.* (*Badister testaceus* Lec. Proc. Acad. Nat. Sc. 2, 252, *Acpus testaceus* ejusd. Ann. Lyc. 4, 413.) The name *testaceus*, being pre-occupied by Dejean's Acupalpus testaceus entering this genus, must be changed.

3. This contains several species like S. ochropezus *Say* (of which S. convexicollis *Lec.* is a variety) in which the posterior angles of the thorax are rounded and the middle tarsi of the males scarcely dilated: here belong S. dissimilis and unicolor *Dej.*

4. The fourth group consists of very small species, having the male tarsi imperfectly, or not at all dilated: the form of the thorax is variable, although the posterior angles are never very prominent. Here belong all the species of Acupalpus, mentioned in the fourth volume of the Annals of the Lyceum, except A. suturalis, which, as above stated, is a Bradycellus. A. micros *Lec.* is not sufficiently distinct from A. testaceus *Dej.*

Trechicus *Zim.*

This genus is proposed to me by my friend Zimmerman, on two small insects from the Southern States, which have very much the appearance of minute Trechus, both by the form of the body and by the elongate acuminate palpi: the males have four joints of the anterior tarsi slightly dilated: the marginal stria of the elytra is entire, not interrupted as in Trechus: the labrum is square and flat, the mentum not toothed; the antennæ are as long as the head and thorax; the 2d and 3d joints equal; the following ones broader and thicker, somewhat moniliate, gradually very slightly increasing in size; the thorax is subtrapezoidal, narrowed behind, with obtuse angles; the elytra are broadly rounded at tip, scarcely striate; the 3d interstice with three impressed punctures; the 8th stria entire, and reaching almost to the suture. The species were first sent me by Zimmerman, under the names that I have adopted.

1. T. umbripennis, testaceus, nitidus, capite nigricante, ore palpis antennisque rufo-testaceis, elytris obsoletissime striatis, cyaneo-micantibus, thorace vix sesqui latioribus, disco et apice infuscatis. Long. ·11. Georgia and Carolina.

2. T. pallipennis, picco-testaceus, nitidus, capite thoraceque nigris, elytris thorace plus sesqui latioribus, pallidis, striis vix distinctis, sutura apiceque late subinfuscatis, pedibus, palpis, antennisque pallidis. Long. ·09. Carolina.

Eucærus *Lec.*

A singular genus which illustrates still farther the affinity towards Trechus, and slightly towards the Lachnophori. The form is altogether that of Trechus, except that the elytra

are broadly truncate behind: the 8th stria is entire, and the 9th continues around the extremity, almost to the sutural stria, as in Lachnophori. The paraglossæ are longer than the ligula, and pointed at their extremity: the mentum is not toothed: the palpi are acuminate at tip: the last joint of the maxillary palpi is scarcely longer than the preceding. The antennæ are filiform, with only the first joint shining: the joints are equal in length excepting the 2d, which is one half shorter. The thorax is rounded, slightly cordate, being narrowed behind, with a short broad lobe at the middle of the base. The feet are slender, the terminal spurs distinct, the posterior tarsi long. Mazoreus is probably allied to this genus, but I have had no opportunity of examining it, and can only judge by description.

E. varicornis, rufo-piceus, nitidus, capite obscuriore, thorace postice angustato, angulis posticis obtusissimis, elytris subtiliter striatis, interstitiis subconvexis, pedibus palpisque flavis, antennis testaceis, articulis 5 ultimis albis. Long. ·15.

One specimen, New Orleans, Mr. Guex. The margin of the thorax is wider towards the posterior angles and reflexed: the disc is slightly convex, the longitudinal line entire, and the transverse impressions distinct: the elytra are iridescent, about twice as wide as the thorax, and one third longer than wide: they have no scutellar stria: the third interstice is bipunctate.

m. *Licini.*

This group approaches the Harpali, but independent of sexual characters, is at once to be distinguished by the glabrous 3d joint of the antennæ. From Pterostichi its separation would appear more difficult; but the impressed labrum and edentate mentum do not occur in that group.

The first two or three joints of the anterior tarsi of the male are broadly dilated with rounded angles, and covered beneath with a dense brush of hairs. The 8th stria of the elytra and its punctures are in the normal position.

The only genera found in the United States are Badister, Diplochila, and Dicælus, all of which have three joints of the male tarsi dilated: some of the species of the first genus have the 3d joint of the antennæ hairy, but not rough as in the Harpali.

To the three species of Badister noted in the fourth volume of the Annals of the Lyceum must be added the two following:

1. B. maculatus, niger, thorace subtransverso, postice angustato, et profundius transversim impresso, angulis posticis rotundatis, elytris striatis, interstitiis fere planis, macula magna humerali, fascia tenui interrupta pone medium, pedibusque flavo-testaceis. Long. ·24.

A single specimen of this pretty species, found at Lancaster, Pa., was given me by Mr. S. S. Rathvon. The sides of the thorax are slightly reflexed towards the posterior angles; the basal impressions are small, the posterior transverse one deep. The humeral spot of the elytra is subquadrate, so the anterior third of their disc appears yellow, the suture alone remaining black: the posterior band is narrow, and consists of a common transverse spot, and a smaller one each side near the lateral margin: the epipleuræ are dull yellow: the feet are bright yellow, and the palpi testaceous; the antennæ are fuscous, with the first joint testaceous.

2. B. flavipes, niger, thorace subovali, postice subangustato et utrinque foveato, angulis posticis valde rotundatis, elytris micantibus, profunde striatis, bipunctatis, interstitiis convexis, antennis fuscis, pedibus flavo-testaceis. Long. ·25.

Two specimens from Louisiana, given me by my friend Dr. Schaum. This species in general appearance resembles B. micans *Lec.*, but the form of the thorax is very different. The thorax is not wider than long, oval scarcely trapezoidal, emarginate in front, rounded on the sides, which are scarcely reflexed, even at the posterior angles, which are much more rounded than in B. micans: the longitudinal line is deep, and abbreviated at the apex: the transverse impressions are faint, the basal impressions are deep and small. The lustre of the elytra is blue mixed with brassy, while in B. micans it is entirely blue and green, without any metallic appearance: the striæ are much deeper, and the interstices more convex: the palpi are dark testaceous.

Diplochila *Brullé*, (Rembus‖*Latr.*)

In this genus I have carefully reexamined the species described by me in the Catalogue above cited, but without coming to any definite result: the variations in form and dimension of the thorax are certainly too great for a single species, and yet no invariable characters have thus far been found for their separation: whatever may be the eventual fate of the species, I may at least assert, that my Rembus major and laticollis are identical, and probably different from C. impressicollis Dej. by their larger and wider thorax. R. obtusus, from Missouri Territory, is entitled to rank as a species, on account of the posterior angles of the thorax being rounded at the apex.

Dicælus *Bon.*

This genus presents great difficulties, since many of the species seem variable in the form and sculpture of the thorax, while others appear unchangeable. The species have been unnecessarily multiplied on slight grounds, and with a large series of specimens, it can be seen that the number may be greatly reduced. For the present I will only indicate the following synonyms:

D. decoloratus *Lec.* (Ann. Lyc. 4, 423,) is probably a very large badly colored specimen of D. splendidus *Say.*

D. violaceus *Bon.*, cyaneus *Dej.*, confusus *Lec.*, and iricolor *Lec.* are varieties of D. purpuratus *Bon.*

D. chalybeus *Dej.* must also probably be united with that species, as its characters appear by no means definite.

D. quadratus *Lec.* (Ann. Lyc. 4, 422,) is D. Lecontei *Ferté* (Ann. Ent. Soc. Fr. 2, 9, 277:) the first name has priority by several years.

D. quadratus *Ferté* seems to be merely D. dilatatus *Say*, Dejean having prepared the way for that error by quoting Say's species as a synonym to his Dejeanii, which is a much larger species, found only in the Southern States.

The smaller black species are also in great confusion on account of the variable nature of the characters. D. obscurus *Lec.* and what I considered as D. ambiguus must be united

with D. simplex Dej.; D. opacus *Ferté*, I cannot identify clearly; specimens sent from France under that name to Mr. Guex, are nothing but D. elongatus of a larger size than usual, but I am inclined to think that the original of Ferté is a true species.

It is difficult to determine whether D. ambiguus *Ferté* (Rev. Tool. 1841, 48; and Ann. Ent. Soc. Fr. loc. cit.) belongs to D. simplex, or to D. reflexus *Lec.*: a new examination of the specimen is required, and should it be found to correspond with D. reflexus, that name must of course be suppressed.

D. ovalis *Lec.* seems distinct from D. furvus *Dej.*; its form is a little broader, the interstices of the elytra are all equal, and the 8th is more acutely elevated.

The two following species are so distinct as to be well worthy of description:

1. D. costatus, oblongus, crassus, niger, subopacus, thorace transverso, lateribus planiusculis, antico valde rotundatis, impressione transversa postica profunda, basalibus parvis, elytris interstitiis subconvexis, 7mo valde elevato. Long. ·95—lat. ·38.

Texas: two specimens collected by Lt. Haldeman, and one sent me by Dr. Schaum. This species is related to D. Dejeanii and dilatatus, but the elevation of the whole of the 7th interstice of the elytra at once distinguishes it: the sides of the thorax are much more rounded in front, and the depressed lateral portions are more uniformly flat: the basal impressions are less defined. The elytra are more declivous, and from the greater elevation of the 7th interstice the sides become nearly perpendicular, and they therefore do not appear wider than the thorax.

2. D. crenatus, ovalis, niger, subnitidus, thorace non transverso, antrorsum angustato, lateribus subrotundatis, modice reflexis, elytris postice subattenuatis, striis fortiter punctatis, interstitiis convexis, 7mo postice gradatim minus elevato. Long. ·64.

One specimen from Louisiana, given me by Dr. Schaum, whose name I have adopted. The form of this species and the sculpture of the thorax is very much that of D. alternans *Dej.*: the strongly punctured striæ of the elytra will at once separate it from all others.

n. *Chlænii* (genuini.)

In characters, the insects of this group agree with those of the next, except that the 8th stria of the elytra and its series of punctures are at the normal distance from the margin. The characters to distinguish this group from Platyni and Pterostichi appear to be dependent on sexual structures: the usually dense pubescence of the upper surface, however, is an excellent empirical character, which enables them to be known at once.

The labrum is flat, the mentum toothed: the first three joints of the antennæ glabrous, the anterior tibiæ slender, or very slightly thickened, scarcely spinous at the tip: the males have three joints of the anterior tarsi strongly dilated, with rounded angles, and furnished beneath with a dense brush. The ligula appears to be always dilated and truncate at tip, with distinct paraglossæ: the palpi vary in form according to species, and even sex, so that genera based upon their structure, are by no means satisfactory.

Our genera are Atranus *Lec.*; Eurydactylus *Ferté*; Chlænius *Bon.*, and Dinodes *Bon.*: the North American species of the last is unknown to me.

I have adopted the genus Eurydactylus, although its characters are scarcely different from those ascribed to Dinodes. To Ferté's typical species E. tomentosus (*Epomis toment.* Say,) must be added Chlœnius purpuricollis *Randall*, which I formerly placed in Dinodes.

The species of Chlœnius are very numerous, and many are so closely related that their characters could be developed only in a complete synopsis, which must be postponed for the present. For the sake of avoiding confusion, the following synonyms and corrections may be found useful:

C. apicalis‖*Lec.* (Ann. Lyc. 5, 179,) must be changed to C. posticus, as the name is preoccupied.

C. perviridis *Lec.* (Ann. Lyc. 4, 434) is only a slight variety of C. sericeus.

C. smaragdinus *Chaud.* (Bull. Mosc. 1843,) bears the same relation to C. prasinus.

C. cordicollis *Kirby* (Faun. Bor. Am. 122,) is not synonymous with C. chlorophanus *Dej.* as formerly stated by me.

C. atripennis *Lec.* (Ann. Lyc. 4, 436,) must be united with C. tricolor.

C. cobaltinus *Dej.* and C. congener *Lec.* are both synonyms of C. æstivus *Say.*

C. virens *Chaud.* (Bull. Mosc. 1843,) is evidently C. circumcinctus *Say.*

C. niger *Randall*, has recently been mentioned as C. exaratus *Lec.* by Ferté, (Ann. Ent. Soc. Fr. l. c. 249.)

C. emarginatus‡*Kirby*, is evidently C. impunctifrons *Say*, and not C. tricolor, as formerly stated by me, (Ann. Lyc. 4, 436.)

o. *Oodides.*

A little group, belonging evidently to the Chlœnius series, but remarkably distinguished from all the other groups having the epimera of the mesothorax not diagonally divided, by the close approximation of the series of ocellate punctures to the margin of the elytra, and the confluence of the 8th and 9th striæ. The ligula is free and dilated at tip: the mentum toothed in the middle: the labrum is always flat, the three basal joints of the antennæ glabrous, and the palpi filiform: the prosternum is produced a little posteriorly, in all the species known to me, and the mesosternum is concave: the dilatation of the tarsi of the male is variable in the different genera, but they are always brush-like beneath, as in the two preceding groups.

Ferté, in his revision of Patellimanes, already cited, seems to have entirely overlooked the remarkable sexual differences between the genera of this group, differences which are altogether anomalous in the division "Patellimanes." The genera are thus related:

Tarsi omnes subtus pilosi - - - - -	Lachnocrepis *Lec.*
Tarsi postici subtus glabri.	
Tarsi antici maris articulis 4 dilatatis; (corpus punctulatum)	Anatrichis *Lec.*
Tarsi antici maris articulis 3 dilatatis; (corpus supra lævc.)	
Antennæ filiformes tenues - - -	Oodes *Bon.*
Antennæ crassiores compressæ - - -	Evolenes *Lec.*

LACHNOCREPIS *Lec.*

Corpus elongato-ellipticum, planum; mandibulæ acutæ, prominulæ; labrum subquadratum, antice leviter emarginatum; mentum medio fortiter dentatum; ligula apice dilatata, truncata; palpi tenues, longiusculi, articulo ultimo leviter ovali, non longiore; tarsi omnes minus tenues, subtus dense pubescentes, posteriores articulo 1mo elongato, 3^io^ et 4to inter se æqualibus, 2^ndo^ longitudine intermedio; tarsi antici maris articulis 4 modice dilatatis, quadratis, latitudine longioribus, 4to perparum angustiore: antennæ tenues, filiformes.

The body is longer and more parallel, than in even the narrow species of Oodes; it is moderately acute in front, and obtuse behind. The only species known to me is Oodes? parallelus *Say*, (Trans. Am. Phil. Soc. 4, 420,) which may be thus characterized.

L. parallela, elongato-elliptica, antice acuta, nigro-picea, vix convexa, thorace antrorsum valde angustato, lateribus rotundatis, subdiaphanis et late obsolete depressis, angulis posticis obtusis, basi subemarginata, elytris non latioribus, interstitiis planis, 3^io^ postice unipunctato, antennis palpis tibiis tarsisque picco-testaceis. Long. ·42—lat. ·15.

One specimen, Louisiana, Dr. Schaum. The rounding of the sides of the thorax continues to the base, so that a distinct angle is formed between the thorax and elytra.

ANATRICHIS *Lec.*

Corpus ellipticum, punctulatum antice acutum; mandibulæ acutæ prominulæ; labrum parvum subquadratum; mentum medio fortiter dentatum; ligula apice dilatata, truncata; antennæ tenues filiformes; palpi tenues, longiusculi, articuli maxillarium ultimo fere duplo longiore; tarsi posteriores subtus non pubescentes, sed lateribus setosi; tarsi antici maris articulis 4 leviter dilatatis, oblongis, gradatim angustioribus, subtus spongiosis; tibiæ intermediæ maris intus oblique emarginatæ.

The type of this genus is Oodes minutus *Dej.* (Sp. Gen. 5, 677) the peculiar sexual characters of which indicate the propriety of separating it as a distinct genus: the anterior tarsi of the male have the first four points oblong and slightly dilated, growing successively narrower; the interior face of the middle tibiæ in the male presents an oblique emargination, similar to that of the anterior tibiæ, but less deep: the portion below the emargination is moderately dilated. Apart from these sexual characters, we have nothing to distinguish the genus, except the more elongate terminal point of the maxillary palpi, and the punctulate upper surface of the body.

My specimens of this insect were found in Louisiana; the female was given me by Dr. Schaum, and the male by Mr. Gnex.

OODES *Bon.*

This genus differs from those above described in having the first three joints of the anterior tarsi strongly dilated, nearly equal in breadth, and much wider than the fourth joint: when the 7th stria of the elytra is entire, the dilated joints are oblong; when that stria is obliterated, the dilated joints are broader and transverse. Ferté mentions (Ann. Ent Soc. Fr. 2d Ser. 9, 271,) an O. stenocephalus, which from his very short description may be my O. picipes; but if so, he omits the most important difference between it and O. amaroides, with which he compares it, viz., the absence of the 7th elytral stria.

Our species may be arranged as follows:

A. Elytra stria 7mo integra: 1. O. Americanus *Dej.;* 2. O. amaroides *Dej.*

B. Elytra stria 7mo obliterata; 3. O. picipes *Lec.* (Proc. Ac. Nat. Sc. 2, 52; Ann. Lyc. 4, 431;) 4. O. 14-striatus *Chaud.* (Bull. Mosc. 1843; Lec. Ann. Lyc. 4, 431;) 5. O. cupræus *Chaud.* (l. cit.; Lec. loc. cit. 432,) O. *leucodactylus* Ferté (Ann. Ent. Soc. Tr. 2d Ser. 9, 273;) 6. O. elegans *Lec.* (Ann. Lyc. 5, 180.)

EVOLENES *Lec.*

Corpus ellipticum, læve; antennæ breviusculæ, subcompressæ; palpi filiformes, articulo maxillarium ultimo plus sesqui longiore; mentum medio breviter dentatum; ligula apice dilatata, subrotundata; tibiæ anticæ latiores, spina anteapicali longissima; tibiæ intermediæ valde spinosæ; tarsi subtus non pubescentes; antici maris articulis 3 valde dilatatis, 1mo triangulari, 2^ndo^ et 3^io^ transversis.

This genus differs from Oodes, principally by the less slender form of the antennæ; but the more dilated anterior tibiæ, and the longer and stronger spines of the middle tibiæ also prove the necessity of separating it: the dilated tarsi of the male are as in the second division of Oodes, but the 7th stria of the elytra is as distinct as the rest. Only two species are known to me: the second is Oodes exaratus *Dej.* Sp. Gen. 5, 678.

1. E. impressa, elliptica nigra nitidissima, thorace lateribus postice late depressis, et profunde oblique impressis, elytris subtiliter striato-punctatis, interstitiis planis, postpectore parce punctato, antennis basi vix piceis. Long. ·31.

A unique specimen found in Louisiana, given me by Dr. Schaum.

2. E. exarata, elongato-elliptica, rufo-picea, nitida, thorace lateribus postice obsolete deplanatis, basi utrinque vix obsolete impresso, elytris profunde crenato-striatis, interstitiis vix convexis, postpectore, abdominisque lateribus punctatis. Long. ·23.

Georgia and Alabama; the male was given me by Mr. Haldeman.

Subfam. 3. SCARITINI.

Abdomen of both sexes with six segments: epimera of the mesothorax diagonally divided.

p. *Pseudomorphi.*

But one species of this group is found in the Southern United States, Pseudomorphus excrucians *Kirby*, (*Drepanus Leconteï* Dej.) which I have never seen: judging from the descriptions and figures given by Westwood in the 19th vol. of the Linnean Transactions, of this and allied genera, it is impossible to mistake the relationship between these insects and Ozæna. The ligula and paraglossæ are not sufficiently described, nor is the form of the epimera given, but the peculiar structure of the lower surface of the head, and the insertion of the antennæ under the projecting sides of the front are very distinct in all the figures. Some of the genera appear to have the prosternum produced, which would be a good character for separating this from the next group.

p. *Ozæni.*

Although no species of this group has yet been found in our territory, a species was brought from Mexico, by Lieut. Haldeman, which will probably be found in Texas, on further exploration, having been caught but a few miles south of our boundary. As a means

of illustrating the preceding group, I have thought it useful to detail certain characters which seem to have been overlooked by those who have written upon this group.

A peculiar character, which I have observed in no other Carabide, and which appears also in the figures of the genera of the preceding group is, the insertion of the antennæ under the sides of the front, which are dilated in front of the eyes. The labrum is small and flat; the mandibles in the species below described small and sharp: the palpi cylindrical, with the last joint longer than the penultimate: the chin is deeply emarginate, the tooth of the middle is very small and scarcely distinct: the emargination is nearly filled with the basal membrane of the ligula, as in Lebia; the ligula is slightly dilated at tip: the paraglossæ are broad, rounded, as long as the ligula, and connate with it: the antennæ are filiform, the three or four basal joints sparsely, the others more densely pubescent; the second is so closely articulated with the third that the separation can scarcely be perceived. The head is narrowed behind the eyes; the diagonal suture of the epimera of the mesothorax is very distinct: the parapleuræ are narrow, their posterior appendage is distinct. The abdomen has six ventral segments as usual. The legs (of this species) are compressed and broad, the femora deeply excavated on the under surface; the anterior tibiæ have a very slight emargination internally, with the spurs nearly obsolete; the tarsi are slender, hairy, as long as the tibiæ, with the claws very long and slender.

As not only the differences in the form of the antennæ and legs, already pointed out by Klug in his description of Ozæna testudinea,* exist in this species, but the middle tooth of the mentum is very much smaller than in the typical Ozænæ, it is necessary to consider it as a distinct genus, under the name of Physea *Brullé*, of which Trachelizus *Sol.* is a synonym.

The characters already detailed will tend to show that the Ozænæ must be regarded as a distinct type in the Carabidæ, possessing very slight affinities towards the Brachini, but indirectly allied with the Helluones, through the group succeeding this, which seems composed of species having affinities with Helluo and Ozæna.

The interruption of the lateral margin of the elytra seems to have been first pointed out by Klug, and remarkably distinguishes this from all the other groups: the margin anterior to the tubercle is slightly dilated, but the ocellate punctures are not obvious, and there is no stria adjacent to them. The species which has furnished the material for these notes appears to be new, and may be thus defined.

P. hirta, rufo-ferruginea, nitida, capite thoraceque fere lævibus, hoc valde transverso, lateribus valde dilatatis, rotundatis, concavis subrugosis, angulis omnibus valde rotundatis, basi truncata, elytris breviter pubescentibus, subtiliter granulato-punctatis, granulisque majoribus raris seriatis notatis, epipleuris lævissimis flavis. Long. ·5.

q. *Psydri.*

I have formed this group from two small species which seem to have a tendency towards Morio, but which differ essentially from that genus by their diagonally divided epimera. Taking into consideration the glabrous joints of the antennæ, and the pubescent middle

* Jahrbuch, &c.

tibiæ, they seem to have more relation with the Brosci than with any other tribe, and may properly form the passage from the Ozænæ to that tribe. There are probably many foreign genera which have been considered as allied to Ozæna and Morio, which will enter this group, but as the descriptions never mention the suture of the epimera, and but rarely the form of the antennæ, it would be useless for me to attempt a work which every entomologist with a foreign collection can do for himself. The characters presented by our two species, Psydrus piceus *Lec.* 4, 153; and Haplochile pygmæa *Lec.* (Ann. Lec. 4, 208, *Morio pygmæus* Dej. 5, 512,) are these:—

The antennæ are somewhat granose, the first four or five points shining, the others slightly pubescent; the first joint not longer than the others; the third joint longer than the second or fourth; the head below the eyes is slightly sulcate; the mandibles are short and stout; the labrum transverse, flat; the mentum is deeply emarginate, not toothed; the posterior angles of the thorax are distinct, and the prosternum not prolonged; the abdomen moderately pedunculated; the parapleuræ with a distinct posterior appendage; the anterior tibiæ deeply emarginate, truncate at tip; the middle tibiæ pubescent externally; the ligula dilated at tip; the paraglossæ apparently connate with it, but long and slender.

r. *Metrii.*

This group contains only one genus and one species, so far as known to me: it is Metrius contractus, *Esch.*, the position of which has puzzled entomologists very much. Dejean places it after Notiophilus, with which it seems to have no relation whatever: Eschscholtz says simply that it is a new genus of "Carabidæ simplicipedes," without any indication of its affinities. The following characters will exhibit my reasons for considering it as allied with Broscus, from which it seems to differ only in having the prosternum produced, and the abdomen so large as to shorten the parapleuræ.

The antennæ are slightly thicker towards the extremity: the first four joints smooth, the other growing gradually pubescent, the first joint not longer than the second; the head below the eyes not at all sulcate; the mandibles short, the labrum transverse, flat; mentum deeply emarginate, toothed in the middle; thorax closely united wtih the trunk, prosternum produced so as to cover the mesosternum; anterior acetabula entire, parapleuræ short and broad, posterior appendage sufficiently distinct; anterior tibiæ tolerably deeply emarginate internally, slightly thickened at tip; anterior tarsi of the male with three joints dilated and spongy beneath, the first being much longer and wider than the following; middle tibiæ strongly pubescent, both externally and internally: posterior tibiæ pubescent internally. Elytra with the marginal furrow very narrow, and the ocellate punctures obsolete.

The ligula is dilated, the paraglossæ entirely connate with it, and indistinct. This group with Broscus seems to have a tendency towards Panagæus, of the first division of the preceding subfamily.

s. *Promecognathi.*

But a single species of this group is known to me. P. lævissimus *Chaudoir,** (*Eripus*

* Note sur le groupe des Stomides. Bull. Mosc. 1846.

lævis. Dej.) How far some of the other genera of Chaudoir's "Stomites" correspond in characters with it, must be left for others to determine; it may be here remarked, that Chaudoir's group is evidently very artificial, and after a careful comparison of Stomis with Promecognathus, I find no reason why the former should be removed from the Pterostichi, with which Erichson associated it. The following are the characters seen in Promecognathus.

The anterior tibiæ are slightly dilated, and deeply emarginate: the middle tibiæ are pubescent: the prosternum is not produced posteriorly; the parapleuræ have no trace of a posterior appendage; the marginal stria and punctures of the elytra are very close to the margin; the mandibles are long and prominent; the labrum is short and bisinuate as in Scarites: the mentum is very transverse, not deeply emarginate, with the tooth large; the ligula appears broad; the paraglossæ narrow and short; the first four joints of the antennæ are shining, the first much larger than the others; the remaining joints are covered with pubescence longer and less dense than usual. The tarsi of the males are not dilated.

This group seems to be the passage from the Brosci to the Scaritides, having a slight tendency towards Cychrus.

t. *Scaritides* (genuini.)

This group is abundantly distinguished from all others by the fossorial palmated anterior tibiæ, and by the subgeniculate antennæ, which have the first joint very long.

The parapleuræ have the usual appendage very indistinct and sometimes wanting; the striæ of the elytra are usually obliterated; the marginal groove is entire, and usually granulated to such an extent, as to obscure the series of ocellate punctures, which are in their normal position, not approximated to the margin. In some genera of this group the maxillæ are rounded at the extremity, the ordinary hook being completely wanting; the head is broadly sulcate below the eyes, so that the antennæ can be folded backwards; the mentum is trilobed, the middle lobes being nearly as long as the lateral lobes; the ligula is broad and rounded in Pasimachus, concave and truncate in Scarites. The thorax is truncate behind, with distinct angles, as in Pasimachus, or pedunculate as in Scarites; the tarsi of the males are not dilated. The anterior tibiæ are always emarginate internally. The foreign genera appear to have been founded upon very slight characters, and might probably be diminished in number by careful comparison.

In my monograph of Pasimachus, (Ann. Lyc. 4, 141,) I have proposed two species, which a larger series of specimens has proved to be badly founded: they are P. *assimilis* and P. *rugosus*, which must be united with P. s u b l æ v i s. Pasimachus Californicus *Chaud* (Bull. Mosc., 1850,) is most probably P. p u n c t u l a t u s *Hald*, which is known to me as far west as Utah. The following is new.

P. d u p l i c a t u s, niger, nitidus, thorace postice subangustato, et utrinque impresso, lateribus rotundatis valde marginatis, angulis posticis parvis rectis, elytris postice subacuminatis, seriatim punctatis, seriebus perparia approximatis, versus marginem bicostatis. Long. 1·0—1·18.

Creek boundary, Missouri Territory, collected by Dr. Woodhouse. This species is very similar to P. o b s o l e t u s *Lec.*, but is larger; the thorax is less cordiform, the pos-

terior angles though prominent are smaller; the striæ in P. obsoletus are slight furrows, at the bottom of which are single rows of punctures, while in the present species, the striæ are merely rows of punctures which are alternately approximated: the posterior tibiæ appear to be nearly glabrous internally in both sexes.

u. *Clivinæ.*

The characters of this group are the same as those of the preceding, except that the first joint of the antennæ is not longer than the others; the marginal sulcus of the elytra is still entire, though not granulated; the marginal row of punctures is in the furrow, and therefore more approximate to the margin; the ligula is usually more or less acuminate, and the paraglossæ are distinct; the anterior tibiæ are palmated, but frequently not toothed on the outer margin; the internal emargination is always deep. The thorax is more or less pedunculated, with the posterior angles indistinct, or altogether wanting; the antennæ have two basal joints and part of the third glabrous; they are indistinctly geniculate, but the first joint is not longer than the second or third; the head is slightly sulcate below the eyes.

Most of our species may be found described in Putzeys' elaborate monograph of Clivinæ: some California species have been added by me in the Annals of the Lyceum, vol. 5, and some Lake Superior species, in Agassiz' work on that region: several yet remain to be described, but it would be more useful to make them known in the form of a synopsis at a future time, as they are closely related, and at times difficult to identify.

To the genera already known in our country, Clivina, Schizogenius, Dyschirius, Ardistomis, and Aspidoglossa, I have added a new one, Acephorus, found on the shores of the ocean, at San Diego, California. The following notes on previously described species must be borne in mind.

Schizogenius ferrugineus *Putzeys'* (1846) is Clivina sulcata *Lec.* (Ann. Lyc. 4, 214, 1846.) The first mentioned ought to take precedence, being in a more general work. S. simplex and pluripunctatis *Lec.* (Ann. Lyc. 5, 197) are varieties: the latter name being more applicable must be preserved.

Dyschirius apicalis *Lec.* (Agass. Lac. Sup. 204,) must be changed to D. nigripes, as the former name is preoccupied by Putzeys.

v. *Bembidia*, (genuina.)

A numerous group composed of small species, which in their form of body imitate almost all the other groups, but which by their structure are so intimately related that scarcely any generic differences can be found. Many of them have the last joint of the palpi small and subulate, being the only predaceous land Coleoptera having this form of palpi, with the exception of certain species belonging to the Trechi, from which they differ in having the 8th stria of the elytra entire and deep.

To various members of the preceding subfamily, especially to the Trechi, Platyni, and Pterostichi, they show a strong resemblance, but are distinguished by the episterna of the mesothorax being diagonally divided.

The antennæ have only two glabrous joints, the third being moderately pubescent; the

anterior tarsi of the male have two dilated joints, of which the first is the larger: in Pericompsus, this dilatation is wanting, the tarsi being alike in both sexes. The genus Pogonus belongs in this group; the only American species described, P. minutus *Dej.* has never come under my notice.

I am doubtful respecting the position of Patrobus, which seems to have very strong relations with Pterostichus, and ought probably to form a separate group in the preceding subfamily: the episterna are not as diagonally divided as in the other genera placed here, but their posterior part is slightly triangular in form.

Our genera may be thus arranged:

A. Palpi subulati.	
Oculi nulli - - - - - - -	Anillus *Duval.*
Oculi distincti, tibiæ anticæ oblique truncatæ:	
Antennæ articulo 3to contiguis minore - -	Blemus.
Antennæ articulo 3to contiguis æquali - -	Pericompsus *Lec.*
Oculi distincti, tibiæ anticæ apice recte truncatæ.	
Mentum dente medio plus minusve distincto, integro -	Ochthedromus *Lec.*
Mentum dente medio brevi, emarginato - -	Hydrium *Lec.*
Mentum trilobum, lobo medio non breviore - -	Bembidium *Latr.*
B. Palpi cylindrici - - - - - - -	Patrobus *Dej.*

Anillus was established by Jacquelin-Duval, (Ann. Ent. Soc. Fr. 1851, lxxiii.) upon a very small species found in the southern part of France: among my California insects I find three specimens of a nearly allied species, found under stones at San Jose: no sexual difference can be perceived. It may be thus defined:

A. debilis, apterus testaceus, vix parce pubescens, thorace latitudine non breviore, subcordato, postice valde impresso, angulis posticis minutis rectis, elytris vix obsolete striato-punctulatis, interstitiis subtilissime alutaceis. Long. .05.

Pericompsus is described by me in the Annals of the Lyceum, Vol. 5: it contains Tachys ephippiatus *Say*, and two allied new species.

With Ochthedromus must be united Odontium *Lec.* (Ann. Lyc. 4, 452,) the characters not being sufficient for a well defined genus. The species of Ochthedromus, in which the front is sculptured with converging furrows, (O. angulifer, connivens, cautus, and frontalis *Lec.*) have the labrum smaller than in the other species, and emarginate, but there does not appear to be sufficient difference to enable them to be separated.

Bembidium will contain, then, only the species having impressed square spots on the elytra: in addition to the peculiar form of the mentum, the first joint of the anterior tarsi of the male is much larger than in the other genera.

Of Patrobus, there are known to me three native species: P. longicornis *Say*, (*Americanus* Dej.:) P. angicollis *Randall*, (Bost. Jour. Nat. Hist. 2, 1,) and P. tenuis *Lec.* (*Pterostichus tenuis* Lec. Agass. Lac. Sup. 207:) the type of the latter is a female, and except in the antennæ and episterna of the mesothorax, precisely resembles a Pterostichus.

Pogonus rectus *Say*, as already shown by me, (Journ. Acad. Nat. Sc. 2d ser., 2, 251,) is a species of Loxandrus, a genus of Pterostichi.

x. *Carabi*, (genuini.)

A group containing insects of varied form, usually of large size, and having in common nearly filiform anterior tibiæ, which are not emarginate internally, and which have the usual spurs both placed at the apex: the most remarkable character distinguishing them is the imperfection of the anterior acetabula, the posterior margin of which is membranous, so that the coxa comes in contact with the mesosternum. The prosternum is more or less produced behind; the mesosternum is declivious and carinate anteriorly, and concave posteriorly. The anterior tarsi of the males, when dilated, are spongy beneath: many of the species are remarkable for possessing a greater number of elytral striæ than is found in any of the preceding groups.

Our native genera are Cychrus (including Scaphinotus and Sphæroderus,) Carabus, Callisthenes, Calosoma, Nebria, Notiophilus and Opisthius, besides a new genus allied to Cychrus, below described.*

Of Cychrus, there are in my collection eighteen species, which may be thus classified:

A. Thorax plus minusve cordatus, (tarsi maris parum dilatati.)

a. Thorax valde marginatus.

1. Margine thoracis laterali postice valde dilatato: C. unicolor *Oliv.;* elevatus *Fabr.;* dilatatus *Lec.* (*Scaphinotus flam.*‡Lec.) Scaphinotus heros *Harris* (Bost. Journ. Nat. Hist. 2, 196) belongs to this group: I formerly considered it as identical with C. unicolor, but on comparing the original specimen in the collection of the Academy of Natural Sciences, I find that it differs in having much more convex elytra, being in appearance intermediate between C. unicolor and viduus.

2. Margine thoracis postice vix latiore: C. viduus *Dej.* and Andrewsii *Harris.* C. Leonardi *Harris*, is a variety of the first mentioned.

b. Thorax anguste marginatus.

3. Elytra striata: C. angusticollis *Fischer;* marginatus *Dej.;* ventricosus *Dej. Esch.* (*striatopunctatus* Chaud.;) interruptus *Mén.* (*ventricosus* ‡ Chaud.;) constrictus *Lec.* and cordatus *Lec.;* also C. angulatus *Harris;* cristatus *Harris*, and velutinus *Mén.*, which are unknown to me.

4. Elytra tuberculata: C. tuberculatus *Harris.*

B. Thorax fere rotundatus, tenuiter marginatus (tarsi maris valde dilatati.)

5. C. stenostomus *Weber;* C. nitidicollis; niagarensis; Lecontei; Brevoorti *Lec.* and a new species C. bicarinatus. The second species was first described by Guérin, the third by Laporte, the fourth by Dejean, and the fifth by myself as Sphæroderus.

As a fact in geographical distribution, it may be stated that the species in (B) and (a) are confined to Atlantic North America; those in (b) are only found on the Pacific slope of the continent.

The new species, above mentioned, may be distinguished as follows:

C. constrictus, ater, thorace subopaco, valde cordato, lateribus maxime rotundatis, postice sinuatis, angulis posticis rectis, non prominulis; elytris ventricosis, crenatostriatis, apice acuminatis, interstitiis vix interruptis. Long. ·6.

* Pelophila and Leistus are said to occur in Western North America, but the species are unknown to me.

Two specimens, San Jose, California. Approaches very closely what I consider as C. ventricosus, but the thorax is much more rounded on the sides, which are strongly sinuate towards the posterior angles, while in C. ventricosus they converge obliquely, and are scarcely sinuous in their outline.

C. c o r d a t u s, niger, nitidus, thorace cordato, lateribus valde rotundatis, postice sinuatis, angulis posticis rectis, elytris minus convexis, thorace plus sesqui latioribus, apice acuminatis, profunde crenato-striatis, interstitiis vix interruptis. Long. ·48.

One male, San Jose, California. This species is closely allied to the preceding, but in comparing the same sex, the elytra are so much less convex, more parallel, and less declivous at the extremity, that I am obliged to consider them as distinct species.

C. b i c a r i n a t u s, niger, subpurpurascens, thorace rotundato, latitudine non breviore, basi truncato, punctato, et utrinque valde profunde impresso; elytris æneo-atris, planiusculis, confertim crenato-striatis, versus apicem et latera tuberculis nitidis granulosis, costaque versus marginem acute elevata postice abbreviata, ornatis. Long. ·6.

A fine species, of which I found but a single specimen in Habersham Co., Georgia. It resembles C. niagarensis, but the thorax is not wider than its length; the elytra are more tuberculate posteriorly, and the acutely elevated costa, near the margin, extending from near the base to within one fifth of the apex at first sight distinguishes it.

Nomaretus *Lec.*

Instrumenta cibaria et alia, sicut in Cychris; differt tamen antennarum articulis duobus tertiisque basi glabris; tarsi maris antici levissime dilatati; elytra 11-striata.

These species, although very similar to Cychrus, differ so remarkably in the antennæ and the number of striæ of the elytra, that I have thought it necessary to separate them. In Cychrus the first four joints of the antennæ are entirely glabrous, and the elytra have at least fourteen striæ on each.

The three species resemble in appearance the small Cychri from Western America, rather than those of the Atlantic side.

1. N. b i l o b u s, purpureo-æneus, thorace cordato, valde canaliculato, postice valde angustato, basi punctato, et valde transversim impresso, angulis posticis obtusis, elytris striis 11 profundis crenatis, apice confusis. Long. ·52.

Cychrus bilobus Say, Trans. Am. Phil. Soc. 2, 73; Lec. Agass. Lac. Sup. 208, tab. 8, f. 6.
Sphæroderus bilobus Dej. Sp. Gen. 2, 16.

Lake Superior and Ohio.

2. N. f i s s i c o l l i s, niger, nitidus, thorace obovato, valde canaliculato, postice angustato, profunde transversim impresso, angulis posticis obtusis, elytris splendide violaceis, striis 11 profunde crenatis, apice minus impressis. Long. ·42.

One specimen, Illinois; Mr. Willcox. Easily distinguished by the thorax being impunctured, and by the punctures of the striæ of the elytra being larger and less close; the thorax is less narrowed behind than in N. bilobus.

3. N. d e b i l i s, niger, nitidus, thorace latitudine longiore, modice canaliculato, cordato, postice

angustato, et lateribus sinuato, basi valde transversim impresso et utrinque exarato, angulis posticis rectis, elytris elongatis, ellipticis, 10-striatis, striis profunde crenatis, 9ma indistincta; ore antennisque rufo-piceis. Long. ·38.

A very distinct and singular species, of which I found one specimen in Habersham Co,. Georgia. The basal impressions of the thorax in the other species are small and lost in the deep transverse impression; in this they are long and deep.

Calosoma *Fabr.*

Having inadvertently named a remarkable species of this genus C. angulatum, (Ann. Lyc. 5, 199,) I now propose to change the name to C. p r o m i n e n s, the name first given being preoccupied by Chevrolat for a Mexican species, which also has the sides of the thorax strongly angulated. The two following species are new:

1. C. l u g u b r e, nigrum, nitidum, fronte parce punctata, thorace brevi, lateribus subangulatim valde rotundatis, basi truncato, utrinque late impresso, elytris thorace sesqui latioribus, seriatim punctatis, punctis versus basin maioribus, et rugis transversis coniunctis. Long. 1·08.

One male, from New Braunfels, Texas, collected by Mr. Lindheimer. This species has the form of C. t r i s t e *Lec.*, but is much larger; the thorax is more suddenly rounded on the sides, and the three series of impressed foveæ of the elytra are scarcely to be traced; the large punctures of the anterior fourth of the elytra are very conspicuous; all the tibiæ are straight.

2. C. m a e r u m, elongatum, nigrum, nitidum, fronte parce punctata, thorace latitudine sesqui breviore, antrorsum angustato, lateribus rotundatis, postice latius subreflexis, purpurascentibus, basi truncato, utrinque late impresso, elytris thorace vix latioribus, purpureo-marginatis, vix obsoletissime striatis et punctis triplici serie impressis, ante medium vage grosse punctatis. Long. 1·05.

Texas; Lieut. Haldeman and Mr. Lindheimer. This species has the same form as C. e x t e r n u m (*Carab. extern.* Say; *Calos. longipenne* Dej.) It is remarkable for the almost entire absence of the usual striæ and foveæ: the tibiæ are straight in both sexes. The elytra of the male are not wider than the thorax; those of the female are about one third wider.

Nebria *Latr.*

N. R a t h v o n i, nigra depressa, thorace transverso, marginato, postice magis angustato, lateribus antice valde rotundatis, postice sinuatis, basi punctulato, utrinque impresso, angulis posticis rectis, elytris oblongo-ovatis, striis obsolete punctulatis, interstitio 3io punctis tribus, 7mo punctis quinque impressis. Long. ·48.

Sacramento, California; one specimen collected by Mr. Child and given me by Mr. S. S. Rathvon. This species resembles in form N. S a h l b e r g i i *Fisch.*, but is larger; the thorax is more narrowed behind, and more sinuate on the sides: the striæ of the elytra are deeper, and the punctures are altogether differently placed: in N. Sahlbergii the 3d interstice has five punctures and the 7th none.

Opistius *Kirby.*

The locality of this singular insect is Oregon, specimens having been brought from there

by the late J. K. Townsend, and by the Exploring Expedition under Capt. Wilkes. Although by the impressions of the elytra it seems related to Elaphrus, and by the form of the thorax to Bembidium, its true affinities are undoubtedly with the present group, on account of the form of the pro- and mesosternum, and the imperfection of the anterior acetabula. It seems to be the true osculant between the Carabica and the water beetles, through Amphizoa: Omophron, though somewhat aquatic in its form and habits, has, as we shall hereafter see, no claims to be considered an osculant genus.

γ. *Elaphri.*

The characters of this group, in the series having the parapleuræ without an appendage, consist in the anterior acetabula being entire, the prosternum not prolonged posteriorly, and the maxillæ towards the base being armed with several long bristles, or spines. This last character exists also in some of the genera of the preceding group: such are, however, readily separated by the form of the anterior acetabula.

The mesosternum is declivous, and usually slightly concave: the anterior tibiæ are more or less emarginate internally, one of the spurs being placed at the tip and the other a short distance above: the paraglossæ are distinct; the first four joints of the antennæ are glabrous. The first three joints of the anterior tarsi of the males are dilated and spongy beneath.

On account of the structure of the epimera of the mesothorax, and the absence of any appendage to the parapleuræ, I have placed Loricera in this group: its strongly bearded maxillæ show its affinity with these insects, nor can I conceive how it has ever been considered as related to Chlænius, or to Panagæus.

Our genera may be thus arranged.

Antennæ verticillato-setosæ; mentum dente lato, obtuso, - -	Loricera *Latr.*
Antennæ simplices; mentum dente longo emarginato:	
Palpi maxillares articulo ultimo præcedente vix sesqui longiore	Blethisa *Bon.*
Palpi maxillares articulo ultimo præcedente plus duplo longiore	Elaphrus *Fabr.*

The genera Opisthius and Notiophilus have been removed from this group to the preceding, on account of the form of the sternum and anterior acetabula.

Of Loricera, there are four species known from North America: L. pilicornis *Latr.* from Lake Superior: L. semipunctata *Esch.* and L. foveata *Lec.* from California, and L. decempunctata *Esch.* from Sitka.

Of Blethisa, Haldeman has described a very large species, B. quadricollis (Proc. Acad. Nat. Sc. 3, 149) found at Lake Superior: Dr. Harris has found the same species near Cambridge, Mass., but it appears to be very rare. A species from Oregon, collected by the late J. K. Townsend, has not yet been described;

B. Oregonensis, æneo-nigra, thorace latitudine breviore, postice leviter angustato, lateribus rotundatis, reflexis, angulis posticis subrectis, ad basin utrinque profunde impresso, carinaque externa munito, elytris profundius striato-punctatis, striis externis confusis, interstitiis convexis, 3to foveis quinque, 5to foveis duabus impressis. Long. ·48.

One female, given me by Mr. Willcox. The posterior angles of the thorax are slightly

obtuse, and not at all rounded. The last joint of the maxillary palpi in Blethisa is relatively so much shorter than in Elaphrus, that I cannot agree with Brullé and Erichson in uniting the two genera.

Elaphrus *Fabr.*

The species of this genus are numerous, and difficult to distinguish: the following classification of those known to me may enable them to be more easily recognised.

A. Elytris interstitiis omnibus lævigatis, impunctatis.

Thorax subtus minus subtiliter punctatus	E. politus *Lec.* Agass. Lac. Sup. 209.
Thorax subtus subtilissime punctatus -	E. lævigatus *Lec.* Ann. Lyc. 5, 200.

B. Thorax minus dense punctatus, elytris interstitiis internis lævibus.

Elytra interstitiis externis parce punctatis	E. cicatricosus *Lec.* Ann. Lyc. 4, 448.
Elytra interstitiis externis et versus apicem dense punctulatis - - -	E. Clairvillei *Kirby*, F. Bor. Am. 62.

C. Thorax et elytra confertissime punctata; his spatiis quadratis lævigatis ornatis.

Maior, thorace transverso, lateribus valde rotundatis	E. intermedius *Kirby*, ibid. 63.

Thorax non transversus, angulis posticis prominulis.

Thorax subtus, sternum, abdominisque latera subtiliter punctulata - - - - -	E. californicus *Man.* Bull. Mosc. 1843.
Thorax subtus, &c., distinctius punctata -	E. punctatissimus *Lec.* Lac. Sup. 210.
Thorax subtus, &c., minus subtiliter punctata	E. ruscarius *Say*, Tr. Am. Ph. Soc. 4, 417.

Thorax non transversus, angulis posticis non prominulis.

Thorax subtus, &c., distinctius punctata	E. similis *Lec.* Ann. Lyc. 4, 449.

E. sinuatus *Lec.* (Agass. Lac. Sup. 210,) does not appear in the foregoing table; it is closely allied to E. punctatissimus, but differs in having a narrower thorax with less prominent posterior angles; the elytra are narrower and more sinuate on the sides: as, however, there is not an exact agreement in these respects among all my specimens of E. punctatissimus, I am inclined to believe that for the present it is better to suppress the species.

E. ruscarius also shows a considerable variation in the form of the thorax, quite sufficient to account for E. americanus *Dej.* (Sp. Gen. 5, 588.) The elytra of some of the smaller specimens are comparatively much broader than in others, but after a very close examination I can detect no specific difference.

E. fuliginosus *Say*, (Trans. Am. Phil. Soc., 4, 417,) is probably my E. cicatricosus: only the elytra are described, the rest of the specimen having been lost, so that the determination cannot be considered as certain.

E. obscurior *Kirby* is unknown to me.

z. *Omophrones.*

The very different structure of the prosternum requires this to be separated as a distinct group, though Erichson and most other systematic authors have united it with the preceding: Kirby first proposed to form of it a separate family, which he called *Omophronidæ*, without giving any other character than the absence of a scutellum.

It has been considered by Kirby, and by other writers, that this genus makes among

the Carabica the nearest approach to the *Hydradephaga*, Kirby going so far as to assert that "its cognate forms are all in that tribe." With this view I cannot agree. That it is a water type of Carabica, must be admitted from its habits; but when we find the characteristic difference in the position of the anterior legs, which distinguishes the Carabica from the water beetles, is so much exaggerated in Omophron as to produce a form of prosternum not found in any other genus of Carabica, we must consider the integrity of the type as fully preserved, and we must view the resemblances between Omophron and the water beetles as the result of analogy, attending habits of life, and not as displaying any direct affinity. It may be said that neither in the form of the head, the structure of the antennæ, the position of the anterior feet, the shape of the posterior coxæ, nor in the structure of the legs, does Omophron make any approach to Haliplus or Hydroporus.

The true osculant between the Carabica and water beetles will be found in some genus allied to Nebria, as that group alone makes any approach to the latter tribe in the position of the anterior feet: Opisthius on the one side, and Amphizoa, which, as I have attempted to demonstrate,* is a water beetle, with ambulatorial, instead of natatorial legs, make perhaps the nearest osculation that has yet been found.

The special characters of this group are:

The prosternum is wide, prolonged and truncate at the extremity; it is closely applied to the metasternum, so that the mesosternum is concealed: the anterior acetabula are entire, and more distant than usual from the posterior margin of the prosternum, and from each other; the anterior tibiæ have a small deep emargination internally near the tip; the elytra have fourteen deep striæ: the first joint only of the anterior tarsi of the males is dilated; it is large, oblong and densely spongy beneath. The first four joints of the antennæ are glabrous, and the maxillæ are bearded at base, as in the preceding group. The paraglossæ are connate with the ligula.

There are six species of Omophron known to me within the United States, viz.: O. dentatum *Lec.* (Ann. Lyc. 5, 200;) O. Gilæ *Lec.* ibid.; O. tessellatum *Say*, (*Lecontei* Dej.;) O. americanum *Dej.* (*Sayi* Kirby;) O. labiatum *Oliv. Say, Dej.*; O. nitidum *Lec.* (Ann. Lyc. 4, 117.)

* Proc. Acad. Nat. Sc. 6, 227.

ARTICLE XXVIII.

Revision of the Elateridæ of the United States. By John L. Le Conte, M. D. Read October 21st, 1853.

Before proceeding to the consideration of the characters by which I have been guided in my endeavour to classify the large group of Coleopterous insects herein treated of, it will be proper to allude briefly to what has been already done in relation to this branch of entomology.

After the separation of Eucnemis by Ahrens, Pyrophorus by Illiger, and a few other genera by various entomologists, the first person, who seems to have been convinced of the necessity of a systematic division of the great Linnean genus Elater, was Eschscholtz. This excellent naturalist published, in Thon's Entomologisches Archiv for 1829, a synoptic table of the divisions established upon the species then known to him. Finding, with more extensive researches, the imperfection of the views there given, he afterwards devised another table of genera, based chiefly upon the study of the species in the collection of Count Dejean.

Being prevented by death from concluding his labours, this table remained in a manuscript form for several years, but was eventually published by Mr. Laporte in the fourth volume of Silbermann's Revue Entomologique. Mr. Laporte took occasion, at the same time, to add several new genera to those of Eschscholtz.

The next addition, to our knowledge of the classification of this family, is due to Latreille, who, however, also died before concluding his investigations; the imperfect results of which, unfortunately in a very confused form, are published, as a posthumous memoir, in the third volume of the first series of the Annales de la Société Entomologique de France.

In the first volume of his Zeitschrift für Entomologie, Germar reprinted all of Eschscholtz's synoptic table, that relates to genuine Elateridæ, and then proceeded to the consideration of separate groups of genera; admitting, however, that these groups, founded upon some ideas of Eschscholtz on the value of the lobes of the tarsal joints, were purely artificial, but confessing that until the isolated genera were more fully defined, nothing could be done towards a natural classification: a view repeated by Erichson in his monograph of Elaters with pectinate tarsal claws, in the third volume of the same work.

Several of these artificial groups were elaborated by the editor, in the five volumes of the work just mentioned, while Erichson lent his assistance by monographing those with serrate ungues, and those with truncate prosternal spine.

A number of artificial genera have been constructed by various entomologists, who, however, with the exception of Kirby, in the Fauna Boreali Americana, have not suggested any ideas respecting the classification of the species.*

The genera found in Austria have been carefully described by Redtenbacher in his Fauna Austriaca, but unfortunately with the tendency to adopt the large number of genera founded by Eschscholtz on unimportant characters.

The group of Eucnemides has been revised as a separate family, by Mr. Guérin, in the Annales de la Société Entomologique de France, (ser. 2d., vol. 1,) where numerous very gross errors of Mr. Laporte are corrected.

More recently, Mr. Solier, in the fauna of Chili by Claudio Gay, has described a large number of South American species, which he has distributed into a large number of new genera founded upon the form of the mandibles, mentum, and the proportions of the joints of the antennæ. As no reference is made to the labours of previous investigators, and as care is taken to avoid all mention of the parts of the body, which served as the basis of earlier classifications, the result of this has been to produce confusion, which can only be removed by the comparison of the actual types of the genera established by Mr. Solier with those already known. I may also add, from the study of our native species, that the characters upon which Mr. Solier relies, especially those derived from the form of the mandibles, are difficult to perceive, and when perceived are of no value, since they vary in species which are certainly closely allied. I am happy to confirm my own opinion about this matter, by that already expressed by my friend, Dr. Schaum, in his report on the progress of Entomology during 1851, in Troschel's Archiv. From the impossibility of identifying any of Mr. Solier's genera, I have avoided expressing any opinion of them in the following pages.

Such being a brief sketch of the previous investigations made in this family, I have next to return my grateful acknowledgments to Dr. Melsheimer for the kind assistance rendered me by the loan of the typical specimens of all the species described by him: and to Dr. T. W. Harris for the loan of several types of species described by Say, and, also, for several very interesting nondescript species from his collection.

The descriptions in the following pages are usally diagnoses of the species, as the specific characters in most of the genera are very clear and well-defined. In the genera Pedetes, Elater, and Cratonychus, such is not the case, the species being difficult of recognition, even when typical specimens are before the student. Long and laboured descriptions in such cases are of no avail, and only tend to confuse; in those genera, I have thought it better to make the diagnosis include a description of all those parts of the body, which, after close comparison of *all* the species, I have found subject to change of form

* In the first volume of the Zoological Journal, there is a Monograph of Cebrionidæ, by Mr. W. E. Leach, in which several species are noted as occurring in North America. As it is unfortunately not possible to recognise any of them, the essay will not be referred to in the following pages.

or sculpture If, consequently, any doubt still remains in the determination of the species, it results from the inherent difficulty of the subject, which would not be removed by a greater amount of detail.

Proceeding now to the principles employed in the classification of the species, we must first inquire into the natural limits of the group.

The family of Elateridæ has always been considered as closely allied to the Buprestidæ, in which also the prosternum is prolonged posteriorly and received into the excavated mesosternum; nevertheless, on comparison, great differences are found: in the Buprestidæ, although the anterior coxæ are small and globular, the acetabula in which they are received are composed partly of the epimera of the mesothorax, while in Elateridæ the acetabula, although open posteriorly, are confined to the prosternum; the prothorax thus acquires a greater degree of mobility than is seen in the Buprestidæ: the same structure is seen in the Throscites that has been just noticed in the Buprestidæ. Other differences are seen in the structure of the abdomen: the suture between the first and second segments is more or less obliterated in Buprestidæ, while in all Elateridæ it is as distinct as the other sutures.

From the other groups of serricorn pentamerous Coleoptera, the Elateridæ are distinguished by the small globular anterior coxæ and the prolonged prosternum. The combination then of the four following characters will define the family, as understood by me:

Coxæ anticæ parvæ rotundatæ, non contiguæ in prosterno sitæ, acetabulis postice hiantibus; prosternum pone coxas productum, præcipue mucronatum, in mesosterno excavato receptum; abdomen suturis ventralibus omnibus distinctis; tarsi 5-articulati.

This definition includes the so-called families of Eucnemides and Cebrionides, which differ by unimportant characters, from the genuine Elaterides. The value of these characters will be presently discussed. Accompanying the four essential characters above given, there are others of great constancy, such as:

The antennæ are serrate, flabellate, or pectinate, rarely subfiliform, never clavate, or capitulate; in the males only of certain Eucnemides are the terminal joints enlarged, but they always preserve their serricorn type. The eyes are round, (in Perothops alone are they slightly oval,) and never emarginate: the antennæ are inserted in foveæ, the upper margins of which are more or less defined, usually under the side of the front, immediately in front of the eyes; in Eucnemides the fovea becomes a sinus, which contracts the front at the middle, and the antennæ approach each other, thus becoming farther removed from the eyes. The mandibles are usually small and retracted; in Cebrionides they are longer and prominent; the labrum is distinct in the true Elaterides, indistinct in the other groups; the prosternum is lobed in nearly all of the true Elaterides; not lobed in Campylus, Oestodes, Eucnemides, and Cebrionides; the head is deflexed, and the mouth entirely covered in the Eucnemides (except Melasis and Tharops;) it is applied against the lobe of the prosternum, and consequently moderately deflexed in most Elaterides; not deflexed, but free in Campylus, Oestodes, and in the Cebrionides; the posterior thighs are retractile under the dilated plates of the coxæ, except in Cerophytum, where the coxal plates are obsolete; the plate is slightly emarginate, and usually toothed at the internal angle, thus

exposing slightly the articulation; in the Eucnemides (except Anelastes) the margin is regular, and the articulation entirely concealed; the abdomen has only five ventral segments, except in Cebrio and an allied genus, where the fifth joint is truncate and the sixth becomes prominent. The femora articulate at the apex of the trochanters, which are thus fulcrant; the tarsi are never much dilated, occasionally furnished with membraneous lobes beneath, and usually pubescent; the fifth joint is slender with two equal claws, varying in form, and usually with a small intermediate appendage terminated by two setæ. The tibiæ are usually slender, never fossorial, rarely compressed; in one genus, allied to Cebrio, a tendency to the fossorial form is shown.

The mentum is small, trapezoidal, and inflexed; the base of the maxillæ exposed; the latter have two distinct lobes, the outer one is never palpiform; the last joint of the maxillary palpi is usually dilated, and larger than the preceding; in Tharops and Melasis, however, the terminal joint is oval and pointed, and not much larger than the one before it; in Adrastus alone, of the true Elaterides, it is long and acuminate; and, finally, in the Cebrionides it is cylindrical and truncate; the labial palpi are very small except in the Cebrionides.

From this detail of characters, we would at first be inclined to select for the definition of our three primary groups, (admitting them to be three in number,) the insertion of the antennæ, and the structure of the abdomen, as being those of probably the greatest value. Genera are soon found, however, in which all the other characters of Cebrio are found, and which have the abdomen constructed as in other Elaterides; the form of the mandibles is obviously a character of too little value for a primary division; we are thus forced to divide the entire family into two great groups: Eucnemides, having the antennæ inserted in a sinus, and somewhat approximated, and the clypeus dilated anteriorly; Elaterides, having the antennæ inserted at the margin of the eyes, under the front, which is not dilated anteriorly, and not narrowed at the middle.

The Eucnemides contain three distinct types: Melasis, with the small acute terminal joint to the maxillary palpi, the imperfectly protected mouth, and the hardly approximated antennæ; Eucnemis, with moderately approximate antennæ, and convex deflexed front; Cerophytum, with closely approximate antennæ, and somewhat gibbous front.

The Elaterides divide naturally into two groups: the true Elaterides, with small retracted mandibles, and small labial palpi; and the Cebrionides, with long porrected mandibles, and cylindrical palpi, all of which are moderately elongated.

These tribes, with the exception of the true Elaterides, are so small, that their resolution into genera is attended with no difficulty: it is very different, however, with that large and difficult group, nor have any previous attempts to arrange its contents been attended with any success.

On examining the other groups, with a view to ascertain whether any light could be gained from them, I found, in the genuine Eucnemides, a remarkable correspondence in the elongated basal joint of the antennæ, and the absence of any tooth at the internal part of the coxal plates: the genus Anelastes makes the only exception to this latter character; and the various places given to that curious genus by different authors sufficiently

prove its anomalous nature; the tarsi, although lobed occasionally, are never inflated, or tufted beneath, as in some Elaterides; the mesosternum is similarly constructed in all the genera: I was, therefore, led to regard these as characters of importance, and to try what might be produced by their application to the large and complicated group of genuine Elaters; by this means I obtained three sets:

1. Species having the tarsi uniformly pubescent, sometimes lobed; the prosternum with a long and sharp spine; the mesosternum never protuberant; the antennæ never received in grooves.

These comprise the greater number of ordinary Elaters, and may be divided according to the length of the first joint of the antennæ, and the form of the coxal plates into several smaller groups, and, finally, into genera, as will be seen hereafter.

2. Species having the tarsi more densely pubescent in the form of tufts beneath, never lobed, but frequently swelled out; the mesosternum frequently prominent; the prosternum always lobed, and always armed with a long spine.

These are mostly large species, not so variable in the form of the front or coxal plates as the preceding group, but containing three forms, which, although not having an exact uniformity of structure, are related to each other, and are distinguished by strong contrasts from those of the first group.

a. Those in which the antennæ are received in deep grooves.

b. Those having luminiferous vesicles on the thorax.

c. Those having a prominent mesosternum.

3. Small species in which the mesosternum is also somewhat prominent, but the spine of the prosternum is short and suddenly truncate. The tarsi are pubescent, and their fourth joint is occasionally lobed. This contains only one genus: Cardiophorus.

With regard to the affinity of this family, I have but little to say: the earlier states of the animal will perhaps give us more information; but the time has not yet come for any rational systematic arrangement of the families of Coleoptera among themselves. We are yet too little acquainted with the comparative value of characters to subordinate the relations properly: the results thus far obtained have certainly been very imperfect, and I fear that while the zeal for making known isolated species and genera continues as great as at present, that the time is far distant when any definite results may be expected.

The relation between Buprestidæ and Elateridæ has been very much exaggerated, on account of the ease with which the form of the prosternum enables these families to be distinguished from all others with pentamerous tarsi. The only other evidence of such affinity rests in the resemblance between the larva of Melasis, and that of Buprestidæ: from other grounds, I have great doubt of the propriety of retaining Melasis and Tharops in this family; but as I do not know where else they can be placed, it seems necessary for the present to leave them where they have been placed by others.

The form and structure of the larvæ point more clearly to a relation with the Tenebrionidæ and Melandryadæ; but, besides many other characters, these families differ essentially in having the posterior tarsi of the imago four-jointed. The resemblance, in external appearance as well as in the general arrangement of the parts of the mouth, is, however, very considerable between some of the genera, and certain Melandryadæ, such as Orchesia. The development of the affinities, which exist in that direction, cannot be done, until a thorough revision of the Tenebrionidæ, with a division into groups upon ra-

tional characters, has been made: a Herculean task which might terrify the most adventurous, but which the voluminous and widely-scattered memoirs of Mr. Solier have rendered still more necessary.

The scheme of arrangement, into primary divisions, above indicated, is as follows:—

Subfam. I. EUCNEMIDES.

Antennæ in sinubus insertæ; clypeus antice dilatatus; labrum indistinctum; abdomen 5-articulatum: prosternum antice non vel vix lobatum.

Div. 1. *Melasides.*

Antennæ fere distantes; palpi maxillares articulo ultimo ovali acuto.

Div. 2. *Eucnemides* (*genuini.*)

Antennæ approximatæ; palpi maxillares articulo ultimo magno, dilatato; ungues non pectinati.

Div. 3. *Cerophytides.*

Antennæ valde approximatæ; palpi maxillares articulo ultimo magno dilatato; ungues pectinati.

Subfam. II. ELATERIDES.

Antennæ in foveis lateralibus, sub fronte insertæ; clypeus antice non dilatatus.

Div. 4. *Elaterides* (*genuini.*)

Mandibulæ parvæ, labrum distinctum; abdomen 5-articulatum; palpi labiales breves, maxillares articulo ultimo maiore præcipue dilatato: prosternum præcipue lobatum.

Div. 5. *Cebrionides.*

Mandibulæ elongatæ, porrectæ; labrum indistinctum; prosternum non lobatum; abdomen sæpe 6-articulatum; palpi omnes longiusculi, articulo ultimo cylindrico, truncato.

N. B.—The Catalogue of the described Coleoptera of the United States, by Dr. Melsheimer, being intended merely as an index to descriptions, has not been quoted in this essay for any changes in nomenclature there introduced, as if retained, without special reason and reference, they were intended as mere suggestions, and not as contributions to science.

Div. 1. MELASIDES.

I have constructed this group from two genera, Melasis and Tharops, which differ from Eucnemis by the following characters:—

The head is large, so that the eyes, which are small, become entirely disengaged from the thorax; the antennæ are inserted in emarginations of the clypeus, but are more widely separated at the base than in Eucnemides: the clypeus is emarginate anteriorly in one genus, but the labrum is indistinct: the last joint of the maxillary palpi is oval and acute, very little larger than the preceding joint: the prothorax beneath is truncate, the suture

of the prosternum does not reach the anterior angles of the thorax, but is continued directly to the apexal margin of the inflexed portion.

The mandibles, although short, trigonal, and without any tooth, are more prominent than in the genuine Eucnemides: the anterior margin of the sinus for the antennæ is very distinct, and even elevated, but the posterior margin is obliterated in one of the genera (Tharops.) The margin of the prosternum does not seem to abut against the mandibles, so as to enclose and protect the mouth as in the two other divisions of the Eucnemides: the gula is corneous, and extends as far back as the sides of the head, which, though deflexed, is really inserted by a narrow neck: the anterior margin of the prosternum is furnished with a large inflexed membranous portion, abutting against the gula, and supported by two corneous pillars. I have very great doubts whether this division should be included in the present family, but as I have not yet discovered any other place for it, it must remain for the present.

Melasis *Oliv.*

1. M. pectinicornis, nigro-piceus, cylindricus, tenuiter fulvo-pubescens, capite confertim punctato, subcanaliculato, thorace latitudine breviore muricato, lateribus omnino rectis, postice angustato, angulis anticis porrectis, posticis acutis parvis prominulis, elytris confertim scabris distincte striatis, pedibus antennisque rufescentibus, his articulis 2—6 sensim paulo latioribus, 7—11 valde transversis intus productis. Long. ·26—·32.

Melsheimer, Proceed. Acad. Nat. Sc. 2, 148.

Pennsylvania, Dr. Melsheimer; Ohio, Dr. Schaum. This genus is easily distinguished from the next by the broad and compressed legs: in our species the second joint of the antennæ is nearly as large as the third. The abdomen has an obtuse elevated compressed tubercle at the apex. The clypeus is slightly emarginate at tip, and the small labrum is thus rendered visible.

Closely allied to this, but evidently a different species, and possibly even a new genus, is the following, which has not been found since its description by Say.

Eucnemis quadricollis, "*Body* piceous black with yellowish hairs: *head* with crowded large punctures, longitudinally confluent on the vertex: *antennæ* rather distant at base, not seated in approximated sinuses, but under frontal elevations: second joint more robust than the third, and equally long: fourth joint rather longer than the third: remaining joints obconic subequal, the last a little longer: *palpi* terminal joint oval: *thorax* transverse quadrate with punctures like those of the head, but not much confluent: anterior angles rounded: lateral edges nearly parallel, very slightly contracted towards the posterior angles, which are nearly rectangular, a little acute, not continued backward beyond the line of the base: *elytra* with punctured striæ, and minutely punctured interstitial lines: *pectus* with less crowded punctures than the thorax, middle segment very broad: no groove: *feet* like all beneath dark piceous: *tarsi* a little paler. Length over one fourth of an inch." Indiana. (Say, Trans. Am. Phil. Soc. 6, 186.)

Tharops *Lap.*

1. T. ruficornis niger, tenuiter pubescens, capite thoraceque scabro-punctatis, hoc quadrato, lateribus fere rectis, angulis posticis acutis, linea dorsali pone medium acute impressa, elytris scabro-

punctatis, striis punctatis, luteo-flavis, humero dimidioque postico fuscis, pedibus antennisque rufis, his articulo 3^io^ sequente paulo longiore; femoribus infuscatis. Long. ·21—·3.

Le Conte, Proc. Acad. Nat. Sc. 6, 46.

Melasis ruficornis Say, Journ. Acad. Nat. Sc. 3, 166.

Eucnemis (*Nematodes*) *ruficornis* Say, Trans. Am. Phil. Soc. 6, 187.

Missouri, near Booneville. One specimen has the elytra entirely yellow. The antennæ of the male are strongly flabellate from the fourth joint: the apex of the abdomen of both sexes has three small prominences beneath, of which the middle one is crest-like, and the lateral ones tuberculiform. This species differs from the next by the less elongated third joint of the antennæ.

2. T. obliquus, niger, tenuiter pubescens, capite thoraceque scabro-punctatis, hoc quadrato, lateribus ad apicem paulo rotundatis, angulis posticis acutis, linea dorsali pone medium acute impressa: elytris scabris, striis punctatis, sutura usque ad medium late luteo-testacea, pedibus antennisque rufo-testaceis, his articulo 3^io^ sequentibus duobus æquali, femoribus infuscatis. Long. ·23—·32.

Le Conte, Proc. Acad. Nat. Sc. 6, 46.

Eucnemis obliquus Say, Trans. Am. Phil. Soc. 6, 187.

Ohio, New York, New Hampshire. In six specimens, I can discover no sexual differences: the fourth joint of the antennæ is a little less dilated in one than in the other five: the antennæ after the fourth joint are strongly serrate, almost pectinate, the joints gradually becoming more transverse: the third joint is slender, and as long as the fourth and fifth together. The apex of the abdomen, as in the preceding species, has three small elevations.

Div. 2. EUCNEMIDES.

This division is sufficiently characterized by having the front slightly and uniformly convex, the antennæ moderately approximated, inserted in a deep sinus, with the clypeus expanding anteriorly: the labrum appears merely as an indistinct margin to the clypeus: the prosternum is truncate anteriorly: the lobe seen in Elaterides is represented by a margin separated by an impressed transverse line: the lateral suture is nearly always straight, in Anelastes alone, a little curved, and meets the lateral margin of the thorax at the anterior angle: the posterior spine is short and usually truncate, somewhat as in Cardiophorus: the anterior part of the sides of the prothorax reaches the eyes, which are thus partially concealed. The coxal plates are always distinct, frequently very broad: the first joint of the antennæ is always long; the last joint of the maxillary palpi always dilated, and usually large: the ungues either entire, or with a single tooth at the middle.

I have removed from this division Melasis and Tharops, for reasons before given, and, therefore, modify the synoptic table of genera given by me in the Proceedings of the Academy of Natural Sciences, vol. 6, p. 45, to suit this change of classification.

A. Thorax subtus non sulcatus:

Coxæ posticæ laminis angustis;

intus quadrangulariter paulo dilatatis; - - - Anelastes.

intus non dilatatis - - - - - - Hylochares.

Coxæ posticæ laminis magnis;
intus sensim valde dilatatis, tarsi antici articulo 1mo vix longiore Emathion.
intus subsubito dilatatis (♂ art. 8-11 elongatis) - - Epiphanis.
intus sensim maxime dilatatis (♂ art. 9-11 elongatis) - Euryptychus.

B. Thorax subtus ad latera sulcatus; (coxæ laminis magnis:)
Tarsi articulis 1-3 non lobatis.
Antennæ tenues, subcylindricæ - - - - Fornax.
Antennæ serratæ vel pectinatæ - - - - Eucnemis.
Tarsi articulis 2-4 breviter lobatis - - - - Galba (Dendrochares.)

C. Thorax subtus ad prosterni latera sulcatus: (coxæ laminis mediocribus.)
Tarsi non lobati - - - - - - - Microrhagus.

The native species belonging to these genera have been enumerated by me in the Proceedings of the Academy of Natural Sciences above mentioned. For the purpose of making the present paper complete, I will here add, to what is there contained, diagnoses of Say's species, which are there only mentioned by name. It is necessary first to state, that I have united the genus Isarthrus *Lec.* with Fornax, as being not sufficiently distinct. The genus Onychodon *Newman*, of which I have procured the typical species, must also be united with Fornax: from the very loose manner in which Newman's descriptions were drawn up, the affinity of Onychodon to the Eucnemides has not been recognised; nor is there any thing in his description (except the lateral grooves for the reception of the antennæ) which indicates it to be other than a true Elateride.

Anelastes *Kirby.*

1. A. Druryi, obscure rufo-piceus, subcylindricus, opacus, thorace transverso convexo, lateribus rotundatis angulis, posticis parvis divergentibus, subtiliter scabro, postice canaliculato, elytris striis profundis, interstitiis convexis, scabris. Long. ·15—·6.

Kirby, Trans. Linn. Soc. 12, tab. 21, fig. 2; Guérin, Ann. Ent. Soc. Fr. ser. 2d, 1, 17.
Silenus brunneus Latreille, Ann. Ent. Soc. France, 3, 129.

Southern States, not rare. The front, as in the next species, is faintly channelled anteriorly, the whole upper surface is more scabrous than in the next species, and the sides of the thorax are less rounded: the dilated portion of the posterior coxal plates is emarginate and toothed, a character seen in no other genus of this division.

2. A. Latreillei, obscure rufo-piceus, subnitidus, thorace transverso convexo, subtiliter parce granulato, postice canaliculato, lateribus valde rotundatis, angulis posticis subdivergentibus, elytris profunde striatis, interstitiis subtiliter rugosis et scabris. Long. ·1—·5.

Lec. Proc. Acad. Nat. Sc. 6, 47.

California, collected in the interior of the country by Mr. Child.

Hylochares *Latr. Guerin.*

1. H. nigricornis, subcylindricus, crassiusculus, ater, opacus, capite scabro canaliculato, thorace subtransverso, convexo, lateribus late rotundato, scabro, profunde canaliculato, utrinque ad medium et ad basin transversim profunde impresso, angulis posticis minutis, elytris striis profunde punctatis, interstitiis convexis scabris, antennis pedibusque obscure rufo-piceis. Long. ·6.

Lec. Proc. Acad. Nat. Sc. 6, 47.
Melasis nigricornis Say, Journ. Acad. Nat. Sc. 3, 165.

One specimen, Ohio, Dr. Schaum. The robust subcylindrical form gives it a strong resemblance to the species of the preceding genus, from which it differs principally in having the plates of the posterior coxæ not dilated internally, and the fourth joint of the tarsi slightly lobed. It is awkward that the specific name should belong to a species with brown antennæ.

Emathion *Lap.*

1. E. atropos, elongatus, postice paulo angustatus, nigro-piceus, tenuiter fulvo-pubescens, capite thoraceque rufo-piceis, scabris, hoc latitudine non breviore, lateribus ante medium rotundatis, angulis posticis mediocribus acutis, canaliculato, utrinque ante medium foveato, et pone medium transversim impresso, elytris scabris, tenuiter fere obsolete striatis. Long. ·32.

Lec. Proc. Acad. Nat. Sc. 6, 47.

Eucnemis atropos Say, Trans. Am. Phil. Soc. 6, 187.

One specimen, Louisiana, Dr. Schaum. The third joint of the antennæ is longer than the fourth, and the last six joints are slightly enlarged: the last being, probably, a character belonging to the male: the fourth joint of the tarsi is slightly lobed beneath: in Say's description, by an error commonly called clerical, the last instead of the fourth joint is said to be dilated.

2. E. penetrans, valde elongatus, postice paulo angustatus, ater, subtilissime fulvo-pubescens, subtiliter confertissime scabro-punctatus, fronte linea tenuissima lævi, thorace latitudine sesqui longiore, lateribus parallelis antice rotundatis, pone medium canaliculato, utrinque obsolete bifoveato, elytris tenuiter striatis, antennis pedibusque rufo-piceis. Long. ·22—·3.

Lec. Proc. Acad. Nat. Sc. 6, 47.

Georgia, rare. In my former description, I only mentioned the two anterior foveæ of the thorax, but on re-examination, I find that the posterior pair, just behind the middle, are also visible: the sixth joint of the antennæ, in this species, is not more than half the size of the seventh, while, in the preceding, they are equally enlarged.

3. E. frontosus, nigro-piceus, modice elongatus, grisco-pubescens, capite punctato, linea frontali vix distincta, thorace subtransverso, lateribus parallelis antice rotundatis, confertissime scabro-punctato, postice canaliculato, utrinque vix obsolete foveato, elytris (parallelis?) scabro-punctatis, tenuiter fere obsolete striatis. Long. ·2.

Eucnemis frontosus Say, Trans. Am. Phil. Soc. 6, 187.

Epiphanis canaliculatus Lec. Proc. Acad. Nat. Sc. 6, 46.

One female specimen, Pennsylvania. On comparing this with the preceding species, I do not find sufficient differences to warrant their being retained in separate genera: the fourth joint of the tarsi, however, is smaller, and is not lobed: the form of body is a little stouter, but is different from that of Epiphanis from the thorax not being regularly narrowed in front: the plates of the posterior coxæ, so far as I can examine them, appear to be gradually dilated as in the two preceding species, not suddenly dilated and subtruncate as in Epiphanis cristatus: they are, however, pushed out of place by the pin, and cannot be properly examined: the third joint of the antennæ is a little longer than the fourth: the eleventh is nearly as long as the two preceding. This is evidently Say's species, although, by some strange oversight, I failed previously to identify it as such.

Epiphanis *Esch.*

1. E. cristatus, nigro-piceus, griseo-pubescens, capite punctulato, fronte cristata, thorace subtransverso, antrorsum valde angustato, lateribus rotundatis, subtilius dense punctato, linea dorsali angustata lævi, angulis posticis productis, elytris parallelis, punctatis, tenuiter fere obsolete striatis, antennis pedibusque rufo-piceis. Long. ·20.

Le Conte, Proc. Acad. Nat. Sc. 6, 46.

One specimen found at New York. This species agrees in the form of the body, as well as in all its generic characters with E. cornutus *Esch.* The punctures of the upper surface are not scabrous, and by the great narrowing of the thorax in front, the form of body, usual in the Elateridæ, is at length reached: the last four joints of the antennæ together are equal in length to all the rest: the third is hardly longer than the fourth: the fourth joint of the tarsi is not at all lobed, and the first joint of the anterior pair is as long as the two following united. It is distinguished from the preceding, as well as the next genus, by the plates of the posterior coxæ being more suddenly dilated, and truncate posteriorly, so that they do not extend farther at the middle than at the internal margin.

E. cornutus Esch., Zool. Atlas 1, 10, tab. 4, fig. 6; Mann. Bull. Mosc. (1843) 238: is from Sitkha; it is unknown to me, and seems to differ from the one described above, by its reddish brown colour, with only the head and thorax black, and more prominent crest forming a short horn.

Eurypycnus *Lec.*

1. E. heterocerus, rufo-castaneus, helvo-pubescens, thorace transverso, antrorsum valde angustato, lateribus præcipue antice rotundatis, subtiliter dense punctato, angulis posticis paulo productis, elytris a basi subangustatis, striis tenuibus, interstitiis subtiliter scabro-punctulatis. Long. ·37—·52.

Le Conte, Proc. Acad. Nat. Sc. 6, 46.

Eucnemis heterocerus Say, Trans. Am. Phil. Soc. 6, 186.

Pennsylvania, rare: two specimens from Rev. D. Ziegler and Mr. Rathvon. The last three joints of the antennæ are as long as the preceding, leaving out the elongated first joint: the third is nearly twice as long as the fourth. The general form is that of true Elater, yet, although differing so much in appearance, the distinction of this genus from Emathion is obscure. Neglecting the form of the antennæ as possibly sexual, and the fourth tarsal joint, as it is not lobed in one species of Emathion above described, we find no differences left, except that, in the present genus, the first joint of the anterior tarsi is as long as the three following: the fourth joint is two-thirds the length of the third, and cylindrical; and the plates of the posterior coxæ are very much more dilated internally, and at the middle extend much farther than at the inner margin.

Fornax *Lap.*

Among our species of this genus, which is synonymous with Drhagus *Esch.*, are some in which the claws of the tarsi are suddenly dilated at the base, with the extremity of the dilated portion forming a prominent tooth. The largest of these species is the type of Newman's genus Onychodon. The species separated by me, under the name Isarthrus, must also be placed in this genus, as the slight difference in the length of the third joint

of the antennæ, and the absence of the very short lobe of the fourth joint of the tarsi, are insufficient characters. Our species may, therefore, be arranged in three groups.

A. *Tarsi articulo 4to breviter lobato; ungues ad medium fortiter dentati.*

1. F. orchesides, fusco-piceus, opacus, helvo-pubescens, capite thoraceque dense scabro-punctulatis, hoc antrorsum angustato, latitudine vix breviore, lateribus rotundatis, angulis posticis productis, basi ad medium tripunctata, elytris a basi vix angustatis, subtiliter scabro-punctulatis, tenuiter striatis, pedibus antennisque ferrugineis, his versus apicem attenuatis, articulo 3^io^ sequente vix longiore. Long. ·68.

Onychodon orchesides Newman, Entomological Magazine, 5, 384.

One specimen found at Racine, Wisconsin, given me by Dr. Hoy. This is by far the largest species of Eucnemide yet found in the United States. It seems to be very rare; the unique specimen described by Newman was found at Trenton Falls, in the state of New York.

2. F. bicolor, supra fuscus, opacus helvo-pubescens, capite thoraceque dense scabro-punctulatis, hoc antrorsum angustato, latitudine vix breviore, lateribus antice rotundatis postice subparallelis, angulis posticis productis, elytris a basi angustatis confertim scabro-punctulatis, tenuiter striatis, subtus ferrugineus, antennis articulo 3^io^ sequente longiore. Long. ·37.

Lec. Proc. Acad. Nat. Sc. 6, 47.

Hylocharus? bicolor Melsheimer, Proc. Acad. Nat. Sc. 2, 149.

One specimen found at New York, given me by Mr. Willcox. Resembles in general characters the preceding, but is very much smaller: the middle lobe of the base of the thorax is shorter, and appears to be only bipunctate: the elytra are regularly narrowed from the base, and the third joint of the antennæ is one-third longer than the fourth: a portion of the antennæ is wanting, so that I do not know if they are more slender externally, as in F. orchesides.

B. *Tarsi articulo 4to breviter lobato; ungues non dentati.*

3. F. badius, fuscus, elongatus, helvo-pubescens, capite thoraceque dense subtilius punctatis, hoc latitudine longiore, antrorsum subangustato, lateribus vix late rotundatis, angulis posticis productis paulo inflexis, elytris a basi vix angustatis, scabro-punctulatis, tenuiter striatis, pedibus antennisque obscure ferrugineis, his articulo 3^io^ sequente duplo-longiore, versus apicem non attenuatis. Long. ·31.

Lec. Proc. Acad. Nat. Sc. 6, 47.

Dirhagus badius Melsheimer, Proc. Acad. Nat. Sc. 2, 149.

Dirhagus rufipes? Melsheimer, Proc. Acad. Nat. Sc. 2, 150.

Two specimens found in Pennsylvania: the second joint of the antennæ is longer than the two preceding species, being one-half as long as the third: the fourth joint is shorter than the fifth, which is equal to the following: the third joint is about twice as long as the second, or the fourth. The antennæ are nearly filiform, not being attenuated towards the tip, as in F. orchesides: the ungues of the tarsi are dilated at base, but not toothed: the margin of the thorax is slightly curved inwards at the posterior angles, while in the preceding species it is straight at that part. One specimen has the front indented with a slight longitudinal fovea, and is probably Dirhagus rufipes *Mels.*

4. F. cylindricollis, niger, valde elongatus, tenuissime fusco-pubescens, thorace latitudine longiore, lateribus parallelis, ante medium paulo angustato et rotundato, sat dense punctato, pone medium profunde late exarato, angulis posticis paulo productis, elytris a basi vix angustatis, punctatis, striis obsoletis, suturali sola conspicua, antennis articulo 3to sequente duplo longiore, versus apicem non attenuatis. Long. ·26—·31.

Lec. Proc. Acad. Nat. Sc. 6, 47.

Eucnemis cylindricollis Say, Trans. Am. Phil. Soc. 6, 188.

Middle, Southern, and Western States. The proportions of the joints of the antennæ are as in the preceding: the legs are black, with the tibiæ and tarsi slightly piceous. This species very much resembles the next: the striæ of the elytra are, however, obsolete, the sutural one alone being distinct, and the punctures are more distinct, and less confluent.

5. F. striatus, niger, valde elongatus, tenuissime fusco-pubescens, thorace latitudine longiore, lateribus postice parallelis, antice paulo rotundatis, confertim subtilius punctato, pone medium late exarato, angulis posticis paulo productis, elytris a basi subangustatis, confertim rugose punctatis, striis distinctis, interstitiis paulo convexis, pedibus antennisque rufescentibus, his articulo 3to sequente duplo longiore, versus apicem non attenuatis. Long. ·22—·28.

Lec. Proc. Acad. Nat. Sc. 6, 47.

Middle and Southern States. The feet are sometimes almost rufo-piceous, the antennæ have also a reddish tinge in one specimen: the joints have the same relative proportions as in the two preceding species.

C. *Tarsi articulo* 4to *non lobato; ungues non dentati.*

6. F. spretus, elongatus, fusco-niger, pubescens, thorace latitudine fere breviore, antrorsum angustato, et lateribus rotundato, dense sat grosse punctato, angulis posticis modice productis, elytris sat grosse confluenter punctatis, striis tenuibus, interstitiis externis paulo convexis, pedibus antennisque rufis, his versus apicem paulo crassioribus, articulis 2-12 subæqualibus. Long. ·2.

Isarthrus spretus Lec. Proc. Acad. Nat. Sc. 6, 48.

One specimen, Lake Superior: the punctures of the head are a little smaller than those of the thorax; there is a faintly impressed fovea at the vertex, which is perhaps accidental.

EUCNEMIS *Ahrens.*

From Fornax, this genus seems to be essentially distinguished by the plates of the posterior coxæ being less dilated, and truncate posteriorly, so as to extend no farther at the middle than at the internal margin. The antennæ are either serrate or pectinate, but never filiform, as in Fornax: the ungues are not dentate, and the fourth joint of the tarsi is slightly lobed. The first species, from the bad condition of the specimen in my collection, was incorrectly stated by me to have the tarsi not lobed.

1. E. clypeatus, fusco-niger, fusco-pubescens, capite thoraceque confertim punctatis, hoc latitudine vix breviore, lateribus postice parallelis, ante medium rotundatis, elytris striis vix distinctis, confluenter punctatis, pedibus antennisque totis rufo-testaceis, his serratis, articulo 3° sequente plus sesqui longiore. Long. ·16—·18.

Say, Trans. Ann. Phil. Soc. 6, 189.

Elater clypeatus Say, Ann. Lyc. of New York, 1, 266.

One specimen from Pennsylvania, given me by Dr. Zimmermann; another from Tennessee, sent by Dr. Schaum.

2. E. amaenicornis, niger, opacus, vix pubescens, capite thoraceque confertim minus subtiliter punctatis, hoc latitudine non breviore, antrorsum paulo angustato, lateribus late vix rotundatis, elytris confluenter punctatis, striis sat profundis, versus suturam tendentibus; pedibus testaceis femoribus infuscatis, antennis longe pectinatis, piceis articulis 2 et 3 testaceis, hoc sequente sesqui longiore. Long. ·12—·16.

Say, Trans. Am. Phil. Soc. 6, 189.

Common in the Middle and Southern States. Some of the specimens have the sides of the thorax more rounded than others; these are probably females: the branches of the antennæ do not, however, appear to be shorter than usual in such specimens: the elytra in all of them are tolerably strongly narrowed from the base to the tip, and the striæ on the middle of the disc consequently run together, and vanish before reaching the apex. The head is subject to abnormal impressions: in one specimen there are three occipital grooves: in another, two faint ones just behind the antennal sinus: in a third, there is a broad frontal fovea, such as has been already mentioned in some species of Fornax.

Galba *Esch. Guér.*

The North American species of this genus is unknown to me: a single specimen was obtained in Georgia by my father, who sent it to Count Dejean. On account of the lobes of the second, third, and fourth joints of the tarsi being shorter than in the Galbæ of the eastern continent, Mr. Guérin proposed to form of this species a subgenus Dendrocharis. His description and figures are found in the Annales de la Société Entomologique de France, Ser. 2d, vol. 1, 193; tab. 6, fig. 60—63. As the work is not generally available to American students, I add a translation of Mr. Guérin's description:

G. flavicornis, "Length 9—12 millimetres;" (·35—·47 unc.) "Brown, smooth, convex, with the sides parallel. Antennæ strongly pectinate, a little thicker towards the apex; with the first two joints brown, and the others orange yellow. Anterior tibiæ broad, compressed, ciliate externally, with stiff bristles; tarsi capable of being folded along the tibiæ, with second, third, and fourth joints dilated beneath; the dilatations much less elongated than in Galba marmorata."

Microrhagus *Esch.*

A. *Tarsi articulo 4to paulo dilatato sublobato.*

[M. pygmaeus, fusco-niger, brevissime fusco-pubescens, fronte subcanaliculata, thorace latitudine vix breviore, antrorsum modice angustato, lateribus late rotundatis, sat grosse punctato, angulis posticis productis valde carinatis, linea marginali antice furcata, elytris a basi subangustatis, fortius punctatis, vix striatis, pedibus obscure testaceis. Long. ·18.

A male specimen sent me by Dr. Schaum.* This species has the antennæ subflabellate, as in Euenemis amarnicornis, but as the pectoral grooves are at the side of the prosternum, it cannot be associated with that species. It differs from all the following species in having the marginal line of the thorax double before the middle, and the posterior angles more strongly carinate: the pectoral grooves are well defined and broad: the ungues of the tarsi are slender.]

* This European species is described in connexion with our native species for the purpose of exhibiting the specific characters more clearly; references are, therefore, omitted.

1. M. imperfectus, ater brevissime fusco-pubescens, thorace latitudine breviore, lateribus antice fortius rotundatis, punctato, linea dorsali tenuissima lævi, angulis posticis modice carinatis, linea marginali medio obsoleta, elytris fortius punctatis, vix striatis, pedibus rufis. Long. ·22.

Lec. Proc. Acad. Nat. Sc. 6, 48.

New York and Maryland. The antennæ of the male are dark coloured and slightly pectinate, those of the female are but little darker than the feet, and moderately serrate; the front in one specimen is channeled, but this is a character of but little value in the present group of insects. The marginal line of the thorax is dislocated and interrupted at the middle, the portion from the anterior angle being far above the short posterior portion, which is connected with the base; the pectoral grooves are indistinct posteriorly: the nails of the tarsi are dilated and toothed at the middle.

2. M. subsinuatus, ater vix fusco-pubescens, thorace latitudine breviore, antrorsum subangustato, lateribus obliquis subsinuatis non rotundatis, punctato, postice canaliculato, ad apicem transversim marginato, angulis posticis planis paulo inflexis, linea marginali dislocata, elytris fortius rugose punctatis, vix striatis, tarsis testaceis. Long. ·2.

LeConte, Proc. Acad. Nat. Sc. 6, 48.

Eucnemis triangularis Harris, Trans. Hartford Nat. Hist. Soc. 72.

One male specimen found in the upper part of Georgia. The antennæ are three-fourths as long as the body, and very slightly serrate; the pectoral grooves are deep and well defined; the marginal line from the anterior margin of the thorax in this species almost forms a junction with the carina of the posterior angle, which, from the flattening of the latter, is pushed out of its normal position, and forms the lateral edge; the basal portion of the true marginal line is deflexed as usual, and becomes obsolete in front of the middle. The claws of the tarsi are not toothed.

3. M. triangularis, ater, pubescens, thorace latitudine breviore, lateribus parallelis, apice summa rotundatis, confertim punctato, angulis posticis acutis, breviter fortius carinatis, linea marginali dislocata, elytris a basi angustatis, apice obtusis, fortiter punctatis vix striatis, pedibus testaceis, antennis piceis. Long. ·1—·13.

LeConte, Proc. Acad. Nat. Sc. 6, 48.

Elater triangularis Say, Journ. Acad. Nat. Sc. 3, 170.

Eucnemis triangularis Say, Trans. Am. Phil. Soc. 6, 189.

Southern and Western States. In my specimens, the antennæ are three-fourths as long as the body, and very slightly serrate: the posterior angles are not flattened, as in the preceding species; the anterior part of the marginal line is very short; the posterior extends in front of the middle, and is deflexed, as usual. The pectoral groove is moderately well-defined, and the claws are not toothed. Guérin (Ann. Ent. Soc. Fr., 2d Ser., 1, 187) refers this species to Eucnemis, but Say expressly states (Trans. Am. Phil. Soc., 6, 189) the pectus is canaliculate "each side of the middle." Say seems at first to have considered other species as varieties of this, as in the Journal of the Academy he mentions individuals having the elytra striate, and others with the third joint of the antennæ less elongated. As Say does not mention the flat and incurved posterior angles of the thorax, it will be more prudent to consider this as his species, although somewhat smaller than that required by his description.

B. *Tarsi articulo 4to nec latiore nec lobato.*

4. M. humeralis, opacus, ater, parce fusco-pubescens, thorace latitudine breviore, lateribus parallelis apice summa rotundatis, angulis posticis subcarinatis, linea marginali dislocata, confertim scabro-punctato, medio utrinque subfoveato, elytris fere parallelis apice obtusis confluenter scabro-punctatis, obsolete striatis, basi late rufescentibus, pedibus antennisque rufis, his articulo 3to non angustiore. Long. ·15.

Lec. Proc. Acad. Nat. Sc. 6, 48.

Eucnemis humeralis Say, Trans. Am. Phil. Soc. 6, 189; Harris, Trans. Hartford Soc. Nat. Hist. 72.

Pennsylvania, Dr. Melsheimer; Tennessee, Dr. Schaum. Differs from all the preceding species by the third joint of the antennæ being as wide as the fourth. The antennæ in both specimens are half as long as the body, compressed, but not strongly serrate: the two discoidal foveæ of the thorax are broad, but not deep; there is also a trace of a dorsal impressed line: the marginal line is dislocated, as usual; the anterior portion is very short, and the posterior portion extends nearly to the apex. The claws of the tarsi appear to be indistinctly toothed at the middle.

This species seems subject to variation in colour: the anterior margin of the thorax and the posterior angles are usually tinged with rufous. A specimen sent by Dr. Schaum has the elytra entirely black, but otherwise seems not to be sufficiently distinct.

Div. 3. CEROPHYTIDES.

Although differing greatly from each other, there is such a close accordance in some characters between Cerophytum and Perothops that I have been induced to place them together. The latter genus has been very fully examined by Erichson, and the detail of his observations is given in the third volume of Germar's Zeitschrift. He has placed it among the genuine Elateridæ, considering it as forming a transition to the Cebrionidæ by its more prominent mandibles and cleft ligula. The approximation of the antennæ, however, brings it nearer to the Eucnemides; and it will be found, on comparison, that those points in which it differs from the Eucnemides are precisely those in which it differs from the true Elaterides, and approaches the Cebrionides. I therefore prefer regarding it as an osculant between the latter family and the Eucnemides, and, on account of its general form, and the structure of the head, to be placed next the last mentioned division.

The differences between Cerophytum and Perothops are as follow:

The front of Cerophytum is gibbous, while in Perothops it is only deflexed anteriorly. The mandibles are larger and more prominent in Perothops: the prosternum is furnished with a short rounded lobe in Cerophytum, while in Perothops it is nearly truncate anteriorly: the lateral suture is curved convexly outwards in Cerophytum, and is straight in Perothops: the laminæ of the posterior coxæ are somewhat suddenly dilated internally in Perothops, and are entirely obsolete in Cerophytum: the posterior trochanters are very long in Cerophytum, and moderate in Perothops: the tarsi are lobed and spongy in Cerophytum, with the first joint longer and the fourth joint bilobed: in Perothops the joints are short, diminish very gradually in length, the first being much thicker, and are very densely pubescent.

The strong points of resemblance are as follows:

The antennæ are closely approximated, inserted in a deep sinus; the labrum is indistinct, being connate with the clypeus, which is dilated in front of the antennæ: the first joint of the antennæ is elongate; the anterior coxæ are more widely separated than in the true Elateridæ, and the posterior spine is short; the last joint of the palpi is very large and triangular; the tarsi are short, and the claws pectinate.

Cerophytum *Latr.*

1. C. pulsator, ater, opacus, capite thoraceque fusco-pubescentibus, hoc convexo, latitudine fere sesqui breviore, lateribus antice valde rotundatis, confertim punctato, angulis posticis minutis prominulis, elytris striis punctatis, interstitiis planis scabro-punctatis. Long. ·27—·33.

Haldeman, Proc. Acad. Nat. Sc. 3, 348; LeConte, ibid. 6, 230.

Chorea pulsator Haldeman, Proc. Acad. Nat. Sc. 3, 150.

Pennsylvania; Ohio. The female was given me by Mr. Haldeman, the male by Dr. Schaum. The latter is more slender than the female; the third to the tenth joints of the antennæ are furnished with a stout branch near the base, externally; the last joint is longer, and is thickened somewhat towards the tip, as if composed of two joints agglutinated together.

Perothops *Esch. Erichson.*

1. P. mucidus, picco-niger, tenuiter cinereo-pubescens, thorace convexo, latitudine breviore antrorsum valde angustato, lateribus rotundato; angulis posticis brevibus subdivergentibus, subtilissime punctulato, punctis paucis minutis consperso, elytris tenuiter striatis, interstitiis paulo convexis, alutaceis, parce subtiliter punctatis, ore barbato. Long. ·55—·6.

Erichson, Germ. Zeitschr. 3, 117.

Elater mucidus Schönh., Syn. Ins. Supp. 133; (*muscidus*) Say, Ann. Lyc. 1, 256.

Eucnemis muscidus Say, Trans. Am. Phil. Soc. 6, 186.

Elater unicolor Say, Ann. Lyc. 1, 256.

Eucnemis unicolor Say, Trans. Am. Phil. Soc. 6, 186.

Middle and Southern States. E. muscidus *Say* is a brown, not fully coloured variety.

Div. 1. ELATERIDES, (*genuini.*)

The genera of this division are very numerous, and seem to have been very unnecessarily multiplied on slight grounds. They are all characterized by having the mandibles small and retracted, and the antennæ widely separated, inserted very near the eyes in deep foveæ: the clypeus is never dilated anteriorly, and the labrum is always distinct. The following table expresses the relations of the genera found in this country, in a tolerably natural manner, though the necessity of introducing several new genera, mostly for single anomalous species, is very much to be regretted.

1. *Tarsi subæqualiter pubescentes, sæpe lobati; mesosternum non protuberans; prosternum semper mucronatum; antennæ non receptæ.*

A. Prosternum semper mucronatum, lateribus rectis: frons præcipue concava, vel plana, fossulis antennarum male definitis: coxæ posticæ laminis angustis, intus paulo dilatatis, vix dentatis: antennæ articulo 1mo mediocri; ungues simplices.

A. Prosternum antice truncatum, non lobatum:

Frons producta, marginata, reflexa - - - - - Campylus.
Frons depressa, antice non marginata - - - - Oestodes.

B. Prosternum antice lobatum, rotundatum:

Frons antice marginata; tarsi articulo 1mo elongato;
Tarsi articulis 2 et 3 lobatis, 4to parvo recepto - - Pedetes.
Tarsi articulis non lobatis, 4to non recepto - - - Athous.
Tarsi articulis 2—4 breviter lobatis, 4to non recepto - - Pityobius.

Frons antice marginata; tarsi articulo 1mo non vel vix longiore;
Antennæ articulo ultimo non maiore - - - - Limonius.
Antennæ articulo ultimo maiore - - - - Gambrinus.

Frons antice non marginata;
Tarsi filiformes, articulo 1mo paulo longiore - - - Corymbetes.
Tarsi articulis 2 et 3 lobatis, 4to recepto, 1mo elongato - Asaphes.

B. Prosternum lobatum et mucronatum, sutura concava, antice non exarata: frons præcipue convexa, apice non marginata, fossulis antennarum distantibus bene definitis; coxæ posticæ laminis variis, antennæ serratæ, articulo 1mo mediocri.

Coxæ posticæ laminis postice non truncatis:
Tarsi articulo 1mo longiore - - - - - Crigmus.
Tarsi articulo 1mo vix longiore - - - - - Atractopterus.
Coxæ posticæ laminis postice truncato-emarginatis - - - Ludius.

C. Prosternum, lobatum, et mucronatum, sutura laterali concava, antice exarata: frons valde convexa, apice non marginata: coxæ posticæ non valde dilatatæ, intus minus dentatæ: antennæ vix serratæ, articulo 1mo elongato:

Ungues simplices, palpi dilatati - - - - - Dolopius.
Ungues serratæ, palpi acuminati - - - - - Adrastus.

D. Prosternum lobatum et mucronatum, sutura laterali concava, præcipue antice exarata: frons plus minusve convexa, antice marginata: coxæ posticæ dente interno magno, acuto: antennæ articulo 1mo mediocri.

Ungues simplices: coxæ laminis maxime dilatatis;
Tarsi articulo 3^io^ longe lobato - - - - - Anchastus.
Tarsi articulo 3^io^ breviter lobato - - - - Brachycrepis.

Ungues simplices: coxæ laminis subsubito modice dilatatis;
Tarsi articulis 2 et 3 subtus longe lobatis - - - Dicrepidius.
Tarsi non lobati, filiformes - - - - - Elater.
Ungues simplices; coxæ laminis sinuatim sensim dilatatis - Blauta.
Ungues simplices; coxæ laminis regulariter sensim dilatatis - Cratonychus.

E. Prosternum lobatum et mucronatum, sutura laterali subconcava, antice exarata: frons antice marginata, rotundata: coxæ posticæ laminis intus subito dilatatis, dente rotundato: antennæ articulo 1mo elongato: ungues simplices:

Tarsi articulo 4to lobato, vel simplici - - - - Monocrepidius.

F. Prosternum lobatum et mucronatum, sutura fere recta, non exarata: frons antice marginata; antennæ flabellatæ, articulo 1mo longissimo: coxæ posticæ angustæ, dente interno rotundato.

Hemirhipus.

G. Prosternum lobatum et mucronatum, medio latiore, (sutura inde extrorsum convexa:) frons an-

tice marginata rotundata, parum convexa: antennæ articulo 1mo mediocri: coxæ posticæ dente interno vix prominulo: tarsi non lobati:

Ungues simplices: tarsi mediocres setosi - - -	Cryptohypnus.
Ungues medio unidentati: tarsi elongati pubescentes -	Oedostethus.

2. *Tarsi non lobati, subtus densius pubescentes, vel sæpius inflati et penicellati; antennæ sæpe receptæ; mesosternum sæpe protuberans; prosternum semper mucronatum et lobatum: (frons modice vel vix marginata;) (laminæ coxarum angustæ, non vel vix subito dilatatæ.)*

H. Antennæ receptæ; thorax vesiculis nullis:

Antennæ articulo ultimo, non constricto - - -	Adelocera.
Antennæ articulo ultimo constricto - - - -	Agrypnus.

I. Antennæ non receptæ; thorax vesiculis luminiferis:

Antennæ fere 12-articulatæ - - - - -	Pyrophorus.

K. Antennæ non receptæ; mesosternum protuberans; thorax vesiculis nullis:

Frons sensim declivis; tarsi mediocres;

Coxæ posticæ laminis postice sinuatis - - - -	Aphanobius.
Coxæ posticæ laminis non sinuatis - - - -	Melanactes.

Frons subito declivis; tarsi crassiusculi;

Mesosternum distinctum - - - - -	Alaus.
Mesosternum connatum - - - - -	Chalcolepidius.

3. *Tarsi pubescentes, sæpe subtus lobati, nec inflati, nec penicellati; antennæ non receptæ; mesosternum protuberans; prosternum antice lobatum, mucrone postico brevi truncato; (frons marginata, ungues varii.)* - - - - - - - Cardiophorus.

Campylus *Fischer.*

A. *Tarsi articulis 2—4 subtus ad apicem spongiosi.*

1. C. productus, æneo-piceus, fusco-pubescens, thorace planiusculo confertim punctato, latitudine longiore lateribus rectis parallelis, fortius marginatis, margine angulisque posticis rufescentibus, elytris seriatim punctatis, substriatis, interstitiis punctatis et subrugosis. Long. ·58.

Elater (Campylus) productus Randall, Bost. Journ. Nat. Hist. 2, 8.

Lake Superior, two specimens; Maine, Randall.

B. *Tarsi subtus æqualiter pubescentes, non spongiosi.*

2. C. denticornis, ater, parce flavo-pubescens, capite thoraceque grosse confluenter punctatis, fronte thoracisque margine omni pallido, hoc canaliculato, paulo inæquali, antice subangustato, latitudine non longiore, elytris æneo-piceis, substriatis, confertim rugose punctatis, margine vittaque tenui sæpe obsoleta, pallidis. Long. ·13.

Kirby, Fauna Bor. Am. 115; Germar, Linnæa Entom. 1, 150.

Campylus flavinasus Melsheimer, Proc. Acad. Nat. Sc. 2, 219.

Lake Superior, Maine, and Pennsylvania. In the male the sides of the thorax are slightly sinuous, and the antennæ are longer than in the female.

Oestodes *Lec.*

Frons planiuscula, lateribus oblique marginatis, antice non marginata; labrum antice rotundatum; mandibulæ acutæ, edentatæ; antennæ elongatæ, serratæ 11-articulatæ, articulo 1mo breviusculo, 2^{ndo} parvo, 3—5 latis triangularibus, sequentibus sensim angustioribus, 11mo paulo longiore non constricto; palpi articulo ultimo ovali, truncato; prosternum antice truncatum non lobatum, mucrone postico elongato, acuto, lateribus rectis non excavatis; mesosternum non protuberans; coxæ posticæ laminis angustis intus vix latioribus, non dentatis; tarsi tenues pubescentes, articulis 1—4 sensim brevioribus, 5to elongato, unguiculis validis simplicibus.

A curious genus related to Campylus by the absence of the prosternal lobe, and to Corymbites by its tarsi, the first joint of which is not conspicuously longer than the second; the front is entirely that of Corymbetes; the body is long, slender, and subcylindrical.

1. O. tenuicollis, niger, nitidus, glaber, capite parce punctato, thorace vix punctulato, elytris striato-punctatis, interstitiis parce subtiliter rugose punctatis, tibiis tarsisque testaceis, antennis nigris. Long. ·27.

Elater tenuicollis Randall, Bost. Journ. Nat. Hist. 2, 14.

Vermont, Prof. Adams; Maine and Massachusetts, according to Randall. The elytra vary in colour from black to yellow; the intermediate variety has the disc yellow, with the base, margin and suture black. In one specimen the posterior angles of the thorax are yellowish.

In the species of this genus the thorax is convex, longer than wide, parallel on the sides, and slightly constricted near the posterior angles, which are long, acute, divergent, and finely carinated; the base is not fissured, but is marked each side with a tolerably long acutely elevated line; the body is glabrous above, but a few short hairs may be perceived towards the tip and margin of the elytra; the thorax in the male is more constricted posteriorly than in the female, whereby its outline appears less straight.

2. O. graciliformis, niger, nitidus, glaber, capite punctato, thorace subtilius parce punctato, apice angulisque posticis testaceis, elytris striato-punctatis, interstitiis subrugosis, pedibus flavis, antennis fusco-testaceis. Long. ·28.

Elater graciliformis Randall, Bost. Journ. Nat. Hist. 2, 13.

One specimen, Vermont, Prof. Adams. In form precisely similar to the preceding.

Pedetes *Kirby.*

There are a number of North American Elaters having the second and third joints of the tarsi lobed beneath; the first joint considerably elongated; the coxal plates narrow, and the front produced and margined. And although Germar (Zeitschr. 2, 244) complains that he has not been able to detect the lobed tarsi in the species mentioned by Kirby as the type of his genus, this confusion is not to be wondered at, when we remember the very different names applied to the most common European species by the entomologists of different nations.

Our genus seems to be equivalent to Athous, as defined by Latreille, (Ann. Ent. Soc. France, 1st ser., vol. 3,) but by no means what was intended by Eschscholtz, who placed his Athous in a group in which the tarsi are not lobed. The species may be naturally grouped as follows:

A. *Thorax angulis posticis non carinatis, apice rotundatis.*

* *Antennæ articulis 2 et 3 æqualibus 4to minoribus.*

1. P. trivittatus, fusco-testaceus, cinereo-pubescens, thorace convexo, elongato, lateribus rectis, confertim subtilius punctato, elytris rufo-piceis, sutura margineque infuscatis, striis punctatis, interstitiis planis, sat dense punctatis, fronte non impressa. Long. ·4.

Athous trivittatus Melsheimer, Proc. Acad. Nat. Sc. 2, 157.

One specimen in Dr. Melsheimer's collection. This species differs from all the others in having the front not impressed and hardly produced. The antennæ and feet are pale testaceous.

** *Antennæ vix serratæ, articulo 3to 4to æquali, vel vix minore.*

2. P. Brightwelli, fuscus, vel testaceus pubescens, thorace elongato, plus minusve canaliculato, convexiusculo, confertim punctato, elytris striis valde punctatis, interstitiis minus convexis, punctatis et parce rugosis, versus basin impressis et testaceis. Long. ·42—·47.

Kirby, Fauna Bor. Am. 146.

Athous oblongicollis Mels. Proc. Acad. Nat. Sc. 2, 155.

Athous arcticollis Mels. Proc. Acad. Nat. Sc. 2, 156.

Middle and Southern States, not rare. The specimen described by Kirby seems to have been a pale coloured variety of this species, which varies much in colour. In the male the thorax is constricted before the posterior angles, which are slightly divergent; in the female, the sides are straight and the angles do not diverge; the dorsal channel is never deep, and is frequently wanting.

3. P. acanthus, æneo-piceus, pubescens, thorace elongato, convexo, subtilius punctato, angulis rufescentibus, elytris striis valde punctatis, interstitiis minus convexis punctatis, versus basin impressis, epipleuris pedibus antennarumque basi testaceis. Long. ·27—·35.

Elater acanthus Say, Trans. Am. Phil. Soc. 6, 178.

New Jersey, Mr. Guex; a typical specimen in Dr. Harris' collection. Differs from the preceding by its smaller size, and more convex and more finely punctured thorax. Otherwise there appears to be no satisfactory difference; the front is sometimes testaceous; probably pale-coloured varieties will occur.

B. *Thorax angulis posticis subtiliter carinatis, apice rotundatis.*

* *Antennæ articulo 3to 4to æquali*

4. P. scapularis, ater opacus, subtiliter fusco-pubescens, thorace elongato, antrorsum subangustato, confertissime punctato, angulis posticis testaceis, carina angulari margini approximata, indistincta, elytris macula basali lutea, striis punctatis, interstitiis scabro-punctatis. Long. ·4.

Elater scapularis Say, Trans. Am. Phil. Soc. 6, 178.

The typical specimen from New Hampshire kindly loaned me by Dr. Harris. The feet and antennæ are entirely black. The lobes of the tarsi are smaller than in the other species, and with some species contained in Athous, would seem to indicate that the two genera should be united. The antennæ, as in the next species, are elongated.

5. P. cucullatus, testaceus, vel piceo testaceus, fulvo-pubescens, thorace elongato, antrorsum

subangustato, dense punctato, carina angulari obliqua, elytris striis punctatis, interstitiis vix convexis, parce punctatis, antennis pedibusque flavis. Long. ·4—·5.

Elater cucullatus Say, Ann. Lyc. 1, 264; Trans. Am. Phil. Soc. 6, 177.

Athous hypoleucus Melsheimer, Proc. Acad. Nat. Sc. 2, 155.

Athous procericollis Melsheimer, Proc. Acad. Nat. Sc. 2, 156.

Athous strigatus Melsheimer, Proc. Acad. Nat. Sc. 2, 154.

Pennsylvania, Maryland, and Ohio. The sides of the thorax in the female are broadly rounded in front, while in the male, they are entirely straight.

Say's original description does not appear to be sufficient entirely to identify the species, but his subsequent remarks refer to a species having carinated thoracic angles; the type in Dr. Harris' collection is a male of this species. The antennæ in both sexes are longer than the thorax.

Melsheimer's Athous strigatus is merely a very large female (·69 unc.) of this species, showing no specific difference.

6. P. fossularis, nigro-piceus, tenuiter cinereo-pubescens, thorace latitudine longiore, lateribus parallelis antice rotundatis, confertim grossius punctato, pone medium utrinque profunde transversim foveato, angulis posticis subrectis, carina angulari margini approximata fere indistincta, elytris striis profunde impressis, punctulatis, interstitiis subconvexis vage scabro-punctulatis. Long. ·45.

One specimen, New Jersey, Mr. Guex. Easily distinguished by the rounded sides and the coarser punctuation of the thorax, as well as by the two deep impressions half way between the middle and the base. The specimen is apparently a female, as the antennæ do not extend beyond the base of the thorax. The form is more robust than the preceding or next species.

7. P. equestris, ater, subtiliter cinereo-pubescens, opacus, capite thoraceque dense punctatis, rubris, hoc latitudine vix longiore, lateribus rectis, antice rotundatis, angulis posticis nigris, subrectis, carina angulari margini approximata, basi medio nigricante, elytris striis punctatis, interstitiis scabris. Long. ·57.

One specimen, Georgia. The lobes of the tarsi are very narrow and short; the upper surface of the head is red, but the mouth and organs are entirely black. The antennæ are not longer than the thorax, and strongly serrate.

** *Antennæ articulis* 2 *et* 3 *parvis æqualibus.*

8. P. posticus, piceus, fusco-pubescens, thorace elongato, minus convexo, antice vix angustato, lateribus rectis fortius marginatis, diaphanis, apice breviter rotundatis, disco dense punctato, postice canaliculato, basi tota testacea angulis posticis inflexis rotundatis, carina obliqua valde distincta, elytris striis punctulatis, interstitiis planis confertim rugose punctatis, antennis basi pedibusque testaceis. Long. ·48.

Limonius posticus Melsheimer, Proc. Acad. Nat. Sc. 2, 158.

Pennsylvania. I have seen only the typical specimen in Dr. Melsheimer's collection. The antennæ are a little longer than the thorax, tolerably strongly serrate, fuscous black, with the first joint testaceous. Has very much the form and general appearance of Campylus productus; the lobes of the tarsi are very short.

Athous *Esch.*

The species which I include in this genus only differ from those of the preceding genus in not having the second and third joints of the tarsi obviously lobed: the fourth joint, therefore, though only half the size of the preceding, is not received upon it: the first joint is as long as the two following united.

This genus will eventually be merged with the preceding, in which case the two species here described, forming the first group, having the posterior angles of the thorax not carinated, and the third joint of the antennæ equal to the fourth, will enter the division (A**,) before Pedetes Brightwelli; those of the second group will enter (B**.)

A. *Thorax angulis posticis non carinatis.*

1. A. reflexus, piceus, vel obscure testaceus, parallelus, tenuiter cinereo-pubescens, fronte profunde excavata, thorace oblongo, marginato, lateribus fere rectis, angulis posticis subrectis, paulo convexo, sat dense, lateribus confluenter punctato, elytris striis punctatis, interstitiis subconvexis, parce punctatis, subtus rufo-piceus. Long. ·65—·7.

Middle States, rare. Body elongate; beneath, rufo-piceous; above, piceous, rarely testaceous; the suture and margin of the elytra darker. Head coarsely punctured, with the front very much produced, deeply excavated: antennæ a little longer than the thorax, subserrate; second joint small, third equal to the fourth: thorax longer than wide, anteriorly not narrowed, sides very slightly rounded, almost straight, distinctly margined, margin reflexed posteriorly, so that the posterior angles become elevated, as in Pedetes Brightwelli; angles almost rectangular, with a very indefinite trace of a carina; disc slightly convex, coarsely punctured, punctures denser and confluent at the sides: elytra parallel, obtusely rounded posteriorly; striæ punctured, interstices slightly convex, with a few distinct punctures.

2. A. vittiger, niger, tenuiter pubescens, parallelus elongatus, fronte excavata testacea, thorace minus convexo elongato, lateribus vix rotundatis, dense punctato, lateribus testaceo, elytris striis punctatis, interstitiis subconvexis rugose punctulatis, vitta integerrima margineque laterali flavis, antennarum basi pedibusque flavo-testaceis. Long. ·3.

A mutilated specimen from Oregon. The tarsi, so far as can be distinguished, belong to the present genus, and the characters are those of the preceding species: the sides of the thorax are less reflexed posteriorly, and the antennæ are somewhat less serrate.

Allied to this species appears to be Elater rufifrons Randall (Bost. Jour. Nat. Hist. 2, 6) from Maine. It is similarly coloured, but is much larger (·6 inc.) It was found in Maine.

B. *Thorax angulis posticis acute carinatis.*

3. A. discalceatus, fulvo-castaneus, helvo-pubescens, infra late rufo-testaceus, thorace latitudine fere sesqui longiore, (antrorsum angustato, lateribus postice rectis, antice late rotundatis,) angulis posticis subdivergentibus, punctato, elytris tenuiter striato-punctatis, interstitiis vage punctatis. Long. ·5.

Elater discalceatus Say, Trans. Am. Phil. Soc. 6, 169.

The typical specimen found in New Hampshire: in Dr Harris' collection: it is evidently a female, and the antennæ are as long as the head and thorax.

A specimen from Pennsylvania, which I consider as the male of this species, has the sides of the thorax perfectly straight, the posterior angles scarcely diverging, and the antennæ longer than the head and thorax. It is much smaller than the female, (·38 unc.,) and darker coloured. In this and the next species the second and third joints of the antennæ are equal, and, together, not longer than the fourth.

4. A. bicolor, supra ater, pube erecta nigro-grisea vestitus, thorace latitudine fere sesqui longiore, (antrorsum angustato, lateribus paulo rotundatis,) confertim punctato, angulis posticis piceis subdivaricatis, elytris striis tenuibus punctulatis, interstitiis confertim rugose punctulatis, subtus castaneus, antennis pedibusque testaceis. Long. ·35.

One specimen found at New York. It is a female, having the antennæ as long as the head and thorax.

Pityobius *Lec.*

Frons producta, profunde excavata; mandibulæ apice emarginatæ; antennæ elongatæ 11-articulatæ, maris bipectinatæ, feminæ subserratæ, articulis 2 et 3 minoribus, illo minore, 11mo simplici; prosternum antice lobatum, postice mucronatum, lateribus rectis, antice subexcavatis; mesosternum non protuberans: coxæ posticæ laminis angustis intus sensim paulo latioribus, non dentatis: tarsi articulo 1mo elongato, sequentibus duobus æquali, apice subtus spongioso, 2—4 sensim brevioribus subtus breviter lobatis, 5to longiore tenui, unguiculis simplicibus.

The body is long and parallel, not convex; the thorax without basal fissures, with the posterior angles acute, produced and diverging, and marked with an indistinct carina parallel to the margin.

1. P. anguinus, picco-niger, tenuiter pubescens, thorace confluenter punctato, profunde canaliculato, antice utrinque profunde foveato, angulis posticis elongatis, divaricatis obsolete carinatis, elytris striis profundis, valde punctatis, interstitiis convexis subtilius punctatis. Long. ·8—1·0.

This fine species is found in pine forests, but is rare: my specimens came from the Southern States, but Dr. Harris has found it in New Hampshire. The late Mr. Melly sent me, under the name *Caloccrus niger*, (Westwood,) two males, found in turpentine. I have substituted for the specific name that under which it appears in Dejean's catalogue, and have been compelled to change the generic name, as being applicable to but one sex.

Limonius *Esch.*

This genus differs from Athous in having the first and second joints of the tarsi equal or hardly different in length; the fourth is not suddenly smaller than the third, and none of the joints are lobed or spongy beneath. Our species are difficult to distinguish, as they approach very closely in external characters; they may be grouped as follows:

A. Prosternum sutura laterali antice excavata:
- α. Clypeus valde emarginatus - - - - - Sp. 1—2.
  Clypeus late vel vix emarginatus;
- β. Antennæ articulis 2 et 3 parvis, pedibus nigris - - - Sp. 3—4.
- γ. Antennæ articulis 2 et 3 coniunctis 4to maioribus, pedibus rufis Sp. 5—11.
- δ. Antennæ articulis 2 et 3 parvis, pedibus flavis - - - Sp. 12—13.

B. Prosternum sutura laterali vix excavata - - - - Sp. 14—25.

A.—*a*.

1. L. auripilis, plumbeo-niger, grisco-pubescens, clypeo emarginato, aureo piloso, thorace polito, latitudine sublongiore, convexo, minus dense grossius punctato, dense aureo-piloso, basi canaliculato, elytris striis punctatis, interstitiis planis, confluenter punctatis, margine basali rufo, epipleuris pedibusque rufis, antennis nigris, articulo primo præcipue rufo. Long. ·35.

Elater auripilis Say, Journ. Acad. Nat. Sc. 3, 172; Trans. Am. Phil. Soc. 6, 178.

Southern and Western States. A specimen from Alabama, given me by Mr. Haldeman, has the antennæ entirely black: in a specimen from Illinois, the dense hair covering the head and thorax is less yellow than in the others, so that the insect has a dull leaden appearance. The distinction between this and the next species rests on the polished surface of the thorax, and in its less dense punctuation, characters which, though obscured by the dense pubescence, may be readily seen. The lobes of the clypeus in both species are subacute.

2. L. pubicollis, niger, opacus, grisco-pubescens, clypeo emarginato, aureo-piloso, thorace latitudine sublongiore, convexo, dense fere confluenter punctato, aureo-piloso, basi canaliculato, elytris striis punctatis, interstitiis planis fere confluenter punctatis, margine basali rufo, epipleuris pedibusque rufis. Long. ·37—·46.

Georgia, not rare. In all the specimens examined, the antennæ are entirely black: the antennæ of the male are a little longer than those of the female, and more strongly serrate; in both this and the preceding species, the third joint, though not dilated, is scarcely shorter than the fourth.

A.—*β*.

3. L. mirus, ater, supra opacus, tenuiter grisco-pubescens, clypeo concavo, vix sinuato, thorace latitudine longiore antrorsum subangustato, lateribus fere rectis, confertim punctato, elytris striis punctatis vix impressis, interstitiis confertim punctatis, auruntiacis, macula postica communi magna ad apicem extendente nigra. Long. ·37.

One specimen, San Diego, California. Body black, above without lustre, thinly covered with short gray hairs: antennæ longer than the head and thorax; serrate: second and third joints, together, not longer than the fourth: head densely punctured; front moderately produced, slightly concave, anterior margin hardly sinuate: thorax longer than wide, slightly and regularly narrowed in front, scarcely rounded on the sides; disc somewhat convex, very densely punctured; posterior angles not divergent, moderately produced, rounded at tip, carina, as in the other species of the group, short and parallel with the margin: elytra not wider than the thorax, very slightly narrowed from the base, obtusely rounded at the apex; striæ scarcely impressed, strongly punctured, interstices finely and densely punctured; base deeply transversely impressed: colour bright orange, with the posterior third covered with a large black spot, the anterior outline of which is oblique, so that the orange colour extends along the sides almost to the apex. In this species and in the next the last joint of the antennæ is subacuminate; in all the other species known to me it is rounded at tip.

4. L. aurifer, ater, subtiliter cinereo-pubescens, clypeo concavo æneo, thorace latitudine longiore, lateribus vix rotundato, aureo-purpureo nitido, parce punctato, postice canaliculato, elytris fere opacis, striis punctatis vix impressis, interstitiis punctatis. Long. ·21—·32.

Vermont, Prof. Adams; Illinois, Mr. Willcox. This very pretty little species is easily distinguished by its brilliant metallic purple thorax: the antennæ are longer than the head and thorax, and serrate; the second and third joints are equal, and together equal in length to the fourth: the anterior margin of the clypeus is reflexed, and almost straight. In the larger specimen the punctures of the striæ of the elytra are hardly larger than those of the interstitial spaces: in both the base is transversely impressed.

A.—γ.

5. L. interstitialis, æneo-niger, griseo-pubescens, clypeo late emarginato, thorace latitudine longiore dense punctato, angulis posticis carinatis paulo productis, elytris striis acutis, punctulatis, interstitiis planis confertim punctatis, antennis pedibusque rufis. Long. ·6.

Corymbetis interstitialis Melsheimer, Proc. Acad. Nat. Sc. 2, 215.

One specimen from Pennsylvania, in Dr. Melsheimer's collection. This only differs from L. cylindriformis by its larger size, and more finely punctured elytral striæ: I have doubts of its being really distinct.

6. L. cylindriformis, fusco-niger, dense fusco vel griseo-pubescens, clypeo late emarginato, thorace latitudine longiore, dense punctato, angulis posticis carinatis, paulo productis, elytris striis acutis parcius punctatis, interstitiis planis confertim punctulatis, basi margineque sæpe rufescentibus, antennarum basi pedibusque rufis, illis sæpe rufescentibus. Long. ·4—·45.

? Elater cylindriformis Herbst, Käfer, 10, 93; tab. 166, fig. 9.

Elater cylindriformis Say, Jour. Acad. Nat. Sc. 3, 176; Trans. Am. Phil. Soc. 6, 166.

Limonius hirticollis Melsheimer, Proc. Acad. Nat. Sc. 2, 215.

Very abundant in the eastern part of the United States. Although the description given by Say, above cited, may not be sufficient fully to identify this species, his subsequent observations, and the notes under his description of *Elater appressifrons* (Ann. Lyc. 1, 267,) remove all doubt. Herbst's description seems rather to apply to this species, as the Corymbetes, to which it is referred by Germar, and which is El. appressifrons *Say*, has the antennæ nearly black, even at the base: the form of the clypeus is, unfortunately, not mentioned. This determination is confirmed by Dr. Melsheimer, by whom specimens were furnished to Say and Knoch: his L. hirticollis is, however, merely a large female of the same species: it is curious that he should have placed it under a genus different from the preceding closely allied species.

7. L. confusus, æneo-piceus, cinereo-pubescens, clypeo late rotundato, thorace latitudine longiore, antrorsum subangustato, lateribus vix rotundatis, punctato, postice canaliculato, angulis posticis brevibus, subcarinatis, non divaricatis, elytris striis punctatis, interstitiis planis sat punctatis, pedibus picco-rufis, antennis totis nigris. Long. ·37.

One specimen from Lake Superior, and another from New York. This species resembles very closely the next, but may be distinguished by the moderately produced clypeus being rounded anteriorly, not truncate: the antennæ are entirely black, a little longer than the head and thorax, serrate, with the second and third joints subequal, together a little longer than the fourth: the thorax is distinctly but slightly narrowed in front, and scarcely rounded on the sides: the epipleuræ are testaceous at the margin, and the thighs are darker than the tibiæ.

8. L. plebeius, æneo-piceus, minus subtiliter cinereo-pubescens, clypeo truncato, thorace latitudine longiore, antrorsum subangustato (minus in femina) lateribus late rotundatis, punctato, angulis posticis carinatis brevibus vix divaricatis, elytris striis punctatis interstitiis sat punctatis, antennarum basi pedibusque piceo-rufis. Long. ·34—·37.

Elater plebeius Say, Ann. Lyc. 1, 263.

Limonius metallescens Melsheimer, Proc. Acad. Nat. Sc. 2, 158.

Common in the Middle and Southern States. The base of the antennæ is sometimes dark coloured, but never black, as in the preceding species: the second and third joints are equal, and together are longer than the fourth: the clypeus is moderately produced, truncate anteriorly, and even very slightly sinuous. In the females the sides of the thorax are more rounded, and the antennæ are a little shorter than the thorax. The margin of the epipleuræ is always rufo-testaceous.

9. L. æneseens, fusco-æneus, griseo-pubescens, clypeo truncato, thorace latitudine paulo longiore, antrorsum subangustato, lateribus omnino rectis, angulis posticis carinatis brevibus divaricatis, densius punctato, postice subcanaliculato, elytris striis punctatis, interstitiis planis punctatis, pedibus rufis. Long. ·35.

One specimen, New Jersey, Mr. Guex. Allied to the two preceding species, but sufficiently distinct by the perfectly straight sides of the thorax: the posterior angles are short, and continue the line of the sides; they therefore appear divergent: the antennæ are hardly piceous at base; the second and third joints together are longer than the fourth: the margin of the epipleuræ is testaceous.

10. L. æger, fusco-æneus, griseo-pubescens, clypeo truncato, thorace latitudine longiore antrorsum subangustato, lateribus late rotundatis confertim subtilius punctato, angulis posticis vix carinatis brevibus subacutis, elytris striis subtiliter punctatis, interstitiis plane discrete punctatis, antennarum basi pedibusque rufis. Long. ·26.

One specimen, Lake Superior. In form and structure resembles very much L. plebeius, but is much smaller: the thorax is more finely and densely punctured: from the next it is distinguished by its larger size and more densely punctured thorax, as well as by its truncate clypeus: the thorax is scarcely channelled posteriorly.

11. L. quercinus, niger, cinereo-pubescens, clypeo late emarginato, thorace postice canaliculato, latitudine longiore, antrorsum subangustato, lateribus paulo rotundatis, minus dense punctato, angulis posticis vix carinatis subacutis, elytris striis punctatis, interstitiis discrete punctatis, antennarum articulis tribus pedibusque rufis. Long. ·2—·27.

Dejean, Cat. 103.

Elater quercinus Say, Ann. Lyc. 1, 262.

A very common species in every portion of the United States. From the next it may be distinguished by the more acute posterior angles of the thorax, and by the second and third joints of the antennæ being longer than the fourth, as in the preceding species: the posterior angles of the thorax are sometimes piceous, but never yellow, as in the following species.

♂.—δ.

12. L. basillaris, niger, tenuiter cinereo-pubescens, clypeo late emarginato, thorace postice canaliculato, latitudine longiore, lateribus fere rectis antice paulo rotundatis, minus dense punctato,

angulis posticis fere obtusis, flavis vix carinatis, elytris striis punctatis, interstitiis discrete punctatis, pedibus flavis, antennarum articulis 2 et 3 parvis, 1mo vel nigro, vel piceo, vel flavo. Long. ·17—·23.

Elater basillaris Say, Journ. Acad. Nat. Sc. 3, 172.

Abundant every where. I was at first inclined to consider Say's species as merely identical with the preceding, but as in the description he says that the first and second joints of the antennæ are pale rufous, it can refer to no other than the present species. The antennæ are more strongly serrate than usual, and the erect hairs along the margin are very distinct: the second and third joints are equal, and together are shorter than the fourth: the first joint is usually piceous; sometimes it is black: sometimes both the first and the second joints are yellow. The posterior angles of the thorax are very short, and almost obtuse; they are always distinctly yellow: the anterior angles of the inflexed portion of the thorax and the anterior lobe of the prosternum are rufous. The antennæ of the male are longer than the head and thorax; those of the female are shorter.

13. L. semiæneus, picco-æneus, cinereo-pubescens, clypeo late emarginato, thorace latitudine longiore, postice canaliculato, lateribus fere rectis, subtilius sat dense punctato, angulis posticis fere obtusis vix carinatis flavis, elytris vel flavis, vel piceis basi margineque flavis, striis punctatis, interstitiis discrete punctatis, pedibus flavis, antennis nigris, articulis 2 et 3 æqualibus parvis. Long. ·2.

Georgia, not common. Except that the sides of the thorax are scarcely rounded, and the punctures very slightly finer and more dense, I find no differences but those of colour between this and the preceding.

B.

14. L. subauratus, elongatus nigro-æneus (dense?) cinereo-pubescens, clypeo truncato, thorace latitudine sesqui longiore, antice vix angustato, lateribus fere rectis, angulis posticis carinatis subacutis, convexo, postice obsolete canaliculato, punctato, elytris nigro-piceis, striis punctatis, vix impressis, interstitiis punctulatis, pedibus antennisque nigris, his articulo 3io 4to subæquali. Long. ·39.

One specimen from Oregon, Col. M'Call. The pubescence has been nearly destroyed by alcohol, but enough remains at the base of the thorax to show that it was ash-coloured, and tolerably dense. This species has also very much the appearance of a Corymbetes, but the anterior margin of the clypeus, though very slightly prominent, is perfectly well defined.

15. L. pilosus, æneo-piceus, nitidus, pilis longioribus fere erectis cinereis minus dense vestitus, clypeo truncato, margine subreflexo, thorace latitudine longiore, lateribus rectis antice paulo rotundatis, punctato, parcius in medio, angulis posticis carinatis subacutis, elytris tenuiter seriatim punctatis, interstitiis discrete punctatis, antennis pedibusque nigris, illis articulo 3io 2ndo paulo maiore. Long. ·42.

One specimen from San Diego, California. This species is less elongated than the preceding, the thorax is less convex, and the anterior margin of the clypeus is quite prominent and slightly reflexed. The thorax is scarcely channelled posteriorly.

16. L. hispidus, minus elongatus æneo-niger, minus nitidus, griseo-pubescens, capite thoraceque pilis longioribus erectis subhispidis, clypeo truncato, margine distincto, thorace latitudine paulo longiore, lateribus rectis, punctato, postice canaliculato, angulis posticis carinatis vix acutis, elytris tenuiter striato-punctatis, interstitiis densius punctatis, antennis pedibusque nigris, illis articulis 2ndo 3io que subæqualibus, 4to coniunctis longioribus. Long. ·37—·43.

San Francisco, California, abundant. The antennæ of both sexes are moderately ser-

rate: in the male they are longer, in the female shorter, than the head and thorax: the form of body is more robust than in any of the preceding species: the posterior angles of the thorax are almost rectangular.

17. L. dubitans, minus elongatus æneo-piceus, fusco-pubescens, capite thoraceque pilis longioribus subhispidis, clypeo margine antico recto, indistincto, thorace valde convexo, punctato, lateribus rotundatis, angulis posticis parvis subacutis subcarinatis, elytris striis punctulatis, interstitiis vix convexis, dense punctatis, antennis articulis 2 et 3 subæqualibus, 4to coniunctis longioribus. Long. ·5.

New York and Pennsylvania, two females: still more robust and more cylindrical than the preceding, to which it appears to be most nearly allied. The great convexity of the thorax, which is hardly narrower in front than at the base, gives this species somewhat the aspect of Cardiophorus, while by the indistinctness of the anterior margin of the clypeus, it makes the transition to Corymbites.

18. L. canus, piceo-niger, valde elongatus, cinereo-pubescens, capite thoraceque densius pubescentibus, pilisque paucis suberectis vestitis, clypeo truncato, margine vix reflexo, thorace latitudine sesqui longiore, antrorsum angustato, et paulo rotundato, confertim punctato, canaliculato, angulis posticis obtusis subcarinatis apice rotundatis, elytris tenuiter striato-punctatis, interstitiis dense punctatis, pedibus fere piceis, antennis nigris, articulis 2 et 3 subæqualibus, 4to coniunctis longioribus. Long. 39.

One specimen, San Diego, California. The antennæ are longer than the head and thorax, and strongly serrate: the hairs on the thorax are so disposed as to produce a faint longitudinal dark line from the basal depression on each side: the dorsal channel is distinct both at base and apex: the tibiæ and tarsi are paler than the femora. The general form is that of the male of L. cylindriformis.

19. L. anceps, elongatus, picco-æneus, densius cinereo-pubescens, clypeo truncato, vix prominulo, thorace latitudine fere sesqui longiore, lateribus parum rotundatis, sat punctato, angulis posticis subacutis vix carinatis, elytris fuscis striis punctatis, interstitiis discrete punctatis, epipleuris pedibusque obscure rufis, antennis piceis articulo 3to 4to paulo breviore. Long. ·3—·35.

Western New York: specimens from Ohio are also in Dr. Harris' collection. The clypeus, although not prominent, is decidedly margined anteriorly: the absence of the small elevated line at the anterior portion of the inflexed margin of the thorax will distinguish it from L. confusus and L. plebeius, to which it bears a slight resemblance: the form is more slender, being about the same as L. aurifer: the hair on the elytra is so dense as to render the punctures indistinct: the third joint of the antennæ, though not as wide as the fourth, is perceptibly dilated.

20. L. ectypus, elongatus, picco-æneus, densius cinereo-pubescens, clypeo truncato, vix prominulo, thorace latitudine longiore, lateribus late rotundatis, angulis posticis parum productis subacutis, obsolete carinatis, sat dense punctato, postice canaliculato, elytris fusco-testaceis, striis punctatis, interstitiis punctatis, pedibus antennisque testaceis, his articulis 2 et 3 coniunctis 4to vix longioribus. Long. ·35.

Elater ectypus Say, Trans. Am. Phil. Soc. 5, 167.

A typical specimen from Maine, in Dr. Harris' collection. Very much resembles the preceding, but the proportion between the basal joints of the antennæ will at once distinguish it.

21. L. agonus, elongatus, piceo-æneus, densius cinereo-pubescens, clypeo truncato, vix prominulo, thorace latitudine longiore, lateribus late rotundatis, densius punctato, postice canaliculato, angulis posticis vix obsolete carinatis brevibus fere obtusis, elytris fusco-testaceis, striis punctatis, interstitiis punctatis, antennis pedibusque rufo-testaceis, illis articulis 2 et 3 coniunctis 4to vix longioribus. Long. ·38.

Elater agonus Say, Trans. Am. Phil. Soc. 6, 171.

A typical specimen in Dr. Harris' collection: locality not marked. This species is very similar to L. ectypus, but the posterior angles of the thorax are not at all produced, and their apex is not acute: the ordinary carina is very small, and hardly visible.

22. L. definitus, cylindricus piceus, tenuiter pubescens, thorace confertissime punctato, angulis posticis rectis non carinatis subtestaceis, elytris striis profundis punctatis, interstitiis vage punctatis, antennis basi pallidioribus. Long. ·19—·23.

Ziegler, Proc. Acad. Nat. Sc. 2, 268.

Middle and Southern States, rare. In one specimen the elytra are brownish.

23. L. infernus, cylindricus, piceus, tenuiter pubescens, thorace dense grossius punctato, margine omni testaceo, angulis posticis rectis, non carinatis, elytris striis profundis punctatis, interstitiis parce punctatis, pectoribus, pedibus antennisque basi testaceis, abdomine nigricante. Long. ·15—·17.

Pennsylvania and New York, not rare. The under surface of the thorax is usually testaceous; sometimes it is fuscous, with the sutures paler. The pale margin of the thorax is dilated at each angle, so as to appear like four small yellow spots: the disc of the thorax is slightly channelled posteriorly.

24. L. vagus, piceus, subæneus, tenuiter cinereo-pubescens, clypeo medio non marginato, thorace latitudine breviore antrorsum modice angustato, lateribus antice paulo rotundatis, angulis posticis subcarinatis, acutis, divaricatis, subtilius punctato, linea dorsali pone medium lævi, elytris confertim punctatis stria suturali sola vix conspicua, basi margineque plus minusve testaceis, apice obtuse rotundatis, pedibus testaceis femoribus infuscatis, antennis nigris articulis 2 et 3 æqualibus 4to coniunctis longioribus. Long. ·29—·35.

Lake Superior, on the northern shore. This species and the next differ considerably from all the others in appearance, as well as by the absence of the elytral striæ. Nevertheless, on close comparison, nothing of a generic value can be found to separate them. The front is indeed not margined anteriorly, but the lateral margins are slightly advanced, so that it presents, in certain directions, the same truncate appearance seen in other species of the genus. The body beneath is black, slightly bronzed. The elytra of the female are gradually dilated posteriorly, so as to be about one-third wider than the thorax; in the male they are parallel on the sides; in both sexes obtusely rounded at the apex; the sides of the thorax are more rounded anteriorly in the female than in the male.

25. L. estriatus, piceus, subæneus, cinereo-pubescens, clypeo medio non marginato, thorace latitudine fere sesqui breviore, antrorsum angustato, et lateribus rotundato, angulis posticis subcarinatis divaricatis, acutis, subtilius punctato, linea dorsali postice sublævi, elytris subtilius punctatis, striis obsoletis, basi margineque testaceis, apice obtusis, antennis basi testaceis, articulo 3^io^ 2^ndo^ longiore et 4to æquali. Long. ·26.

Eagle Harbor, Lake Superior. Smaller than the preceding, which it resembles very

much, and is readily distinguished by the sides of the thorax being more rounded anteriorly, and the third joint of the antennæ being as long and nearly as wide as the fourth; the feet and under surface are black.

GAMBRINUS *Lec.*

Frons paulo producta, antice recte marginata, subconcava; labrum rotundatum, mandibulæ breves: antennæ articulis 2 et 3 subæqualibus, coniunctis sequente non longioribus, 4—10 triangularibus, gradatim paulo latioribus, ultimo duplo maiore, ovali, obtuso: prosternum antice lobatum, postice muronatum, lateribus rectis, sutura antice vix excavata: coxæ posticæ laminis angustis, intus sensim paulo dilatatis: tarsi pubescentes, longius setosi, articulis 1—4 gradatim brevioribus, 5to iterum longiore, unguiculis simplicibus.

The posterior angles of the thorax are finely carinated, and moderately produced. In form and structure approaches very near to Limonius, but is easily known by the last joint of the antennæ being considerably larger than the others, and by the first joint of the tarsi being longer than the second. To this genus possibly belongs Elater stigma Herbst, (Käfer. 10. 86, tab. 166, fig. 1.) which is, however, unknown to me; Dejean, in his catalogue, places it in Limonius; it seems to differ from the one here described by the feet and antennæ being fusco-testaceous.

The generic name is derived from γαμβρος, *socer*.

1. G. armus, virescenti-niger, nitidus, tenuiter cinereo-pubescens, thorace latitudine longiore, antrorsum subangustato, lateribus rectis, ad apicem subito oblique angustatis, minus subtiliter remotius punctato, postice subcanaliculato, elytris striis fortius punctatis, interstitiis discrete punctatis, macula magna humerali oblonga læte rufa, tarsis piceis. Long. ·34.

Elater armus Say, Trans. Am. Phil. Soc. 6, 171.

One specimen from Georgia. The elytra, as in Limonius, are parallel on the sides, and obtusely rounded at the apex.

CORYMBITES *Latr.*

Frons plana, antice depressa, non marginata; labrum antice rotundatum; mandibulæ breves, acutæ, vel simplices, vel ante apicem dentatæ, vel truncatæ et scalpratæ: palpi articulo ultimo plus minusve dilatato: antennæ plus minusve serratæ (maris interdum pectinatæ) articulis 2 et 3 variis, 11mo sæpe constricto, non maiore; prosternum antice lobatum, postice muronatum, murone non vel vix inflexo, lateribus antice non vel vix excavatis: mesosternum non protuberans: coxæ posticæ laminis angustis, intus paulo dilatatis, non dentatis: tarsi longiusculi, pubescentes (vel subsetosi) articulis 1—4 sensim brevioribus (1mo sæpe vix longiore) non lobatis, 5to longiore, unguiculis integris.

A very extensive, but apparently natural genus, which may be easily divided into groups, for the purpose of facilitating the determination of the species. Some of these groups have received generic names, and, on a first glance, there appear to be certain peculiarities of habit, which render them easy to be recognised. With a large series of species, these differences appear to merge insensibly together, so that no well defined distinctions remain. For this reason, I consider the genera Diacanthus and Pristilophus as untenable: the latter, as founded by Latreille, is perfectly unintelligible, and as reformed by Germar, contains two very distinct forms, of which his first division (forming the genus

Melanactes of the present essay) must receive a distinct name, as the definitions both of Germar and Latreille absolutely exclude it, while the second division must be united with the present genus.

Our species may be grouped as follows:

A. *Tarsi subtus æqualiter pubescentes.*

1. Antennæ subserratæ, articulo 3^io^ cylindrico, sequentibus triangularibus, æqualibus: frons subconvexa; corpus dilatatum, pubescens, elytris præcipue testaceis - Sp. 1—11.
2. Antennæ subserratæ, articulo 3^io^ cylindrico, 4to sequentibus longiore;
   - α. Corpus dilatatum supra præcipue glabrum, frons planiuscula - - Sp. 12—17.
   - β. Corpus valde dilatatum pubescens, frons valde concava - - - Sp. 18.
   - γ. Corpus lineare, supra glabrum, antennis articulis 2 et 3 singulis 4to vix minoribus - - - - - - - - Sp. 19—20.
3. Antennæ serratæ, articulo 3^io^ cylindrico, sequentibus triangularibus, æqualibus, 11mo sub-constricto; corpus lineare, glabrum vel pubescens - - - Sp. 21—24.
4. Antennæ serratæ, articulo 3^io^ dilatato; 4—10 æqualibus, 11mo constricto: frons plana: corpus lineare parallelum - - - - - - Sp. 25.
5. Antennæ serratæ, articulo 3^io^ vario, 4—10 æqualibus, 11mo constricto; frons concava, corpus subparallelum - - - - - - - Sp. 26—31.
6. Antennæ serratæ, articulo 3^io^ triangulari, præcipue 4to æquali, 4—10 æqualibus, 11mo præcipue non constricto; frons subconvexa vel plana: corpus non dilatatum.
   - * Elytra postice rotundatim attenuata:
     - α. Thorax angulis posticis carinatis - - - - - Sp. 32—35.
     - β. Thorax angulis posticis non carinatis - - - - Sp. 36—37.
   - ** Elytra postice oblique attenuata, fortius marginata - - - Sp. 38—41.
7. Antennæ compressæ, vix serratæ, articulo 3^io^ sequenti æquali, 11mo vix constricto: frons concava, corpus præcipue lineare - - - - - Sp. 42—45.

B. *Tarsi articulis 2—4 subtus ad apicem sericeo-spongiosi* - - - Sp. 46—49.

A.—1.

1. C. hamatus, crassiusculus, capite thoraceque atris dense subtilius punctatis, aureo-pilosis, hoc postice canaliculato lateribus rotundatis, angulis posticis subdivergentibus, margineque testaceis, elytris testaceis, macula laterali transversa margineque pone medium fuscis, striis profundis punctatis, interstitiis punctatis, abdomine rufo, pectore nigro, pedibus antennisque testaceis. Long. ·43.

Elater hamatus Say, Trans. Am. Phil. Soc. 6, 170.

New Jersey, Mr. Guex, one specimen. A very peculiar and well marked species, having the form of C. hieroglyphicus, but very distinct by its characters. The third joint of the antennæ is not perceptibly larger than the second; the front is more elevated than usual, and almost angulated at tip, the lateral margins converging so as almost to meet; the palpi are black. The dense golden yellow hair of the thorax conceals the punctures, which are dense, but not coarse; the lateral margin, posterior angles, and inflexed portion are rufo-testaceous; the dorsal channel is distinct posteriorly. The striæ of the elytra are strongly impressed, the interstices convex and densely punctured.

Although the form of the front of this species is nearly that of Cryptohypnus silaceipes, the shape of the posterior coxæ, and the parallel sides of the prosternum, prevent its association with that species.

2. C. rubidipennis, crassiusculus, niger, supra flavo-pubescens, thorace non transverso, ante medium rotundatim angustato, angulis posticis vix divergentibus, dense subtiliter punctato, elytris luridis, striis impunctatis, interstitiis subtilissime punctulatis, pedibus ferrugineis, antennis nigris. Long. ·37—·42.

Lake Superior, not rare. This species differs from the description given of medianus Germ. (Zeitsch. 1, 71) by the impunctured elytral striæ. The form of the body is as in the preceding; the third joint of the antennæ is a little longer than the second, but both together are not longer than the fourth.

3. C. acutipennis, crassiusculus, niger, subflavo-pubescens, thorace subtransverso, antrorsum angustato, lateribus rotundatis, angulis posticis subdivergentibus, dense punctulato, elytris testaceo-piceis, striis vix punctatis, interstitiis distincte punctulatis (apice maris acuminatis,) antennis pedibusque rufo-testaceis. Long. ·38.

Diacanthus acutipennis Germ. Zeitschr. 4, 70.

Two specimens found at Ann Arbor, Michigan. Germar describes the striæ of the elytra as punctured; in one specimen they appear smooth, in the other they are feebly punctured; the female does not differ in form from the preceding species; the male has the apex of the elytra produced and acute. The third joint of the antennæ is one-half longer than the second.

4. C. propola, niger, cinereo-pubescens, thorace latitudine non breviore, apice subangustato, lateribus rotundatis, minus dense punctulato, angulis posticis subtestaceis, elytris lurido-testaceis, macula utrinque lunata, postice concava, ad medium fusca, tenuiter striatis, interstitiis punctulatis, antennis piceis basi testaceis, articulo 3^tio^ 2do sesqui longiore, pedibus piceis, vel testaceis. Long. ·3—·33.

Lake Superior, Eagle Harbour; found also in Western New York. The less densely punctured thorax will distinguish this from the other species of this group. The third joint of the antennæ is shorter than the fourth, although longer than in the preceding species; by this character it forms a transition to C. hieroglyphicus. In my catalogue of Lake Superior insects, this is erroneously placed as *El. curiatus Say*.

5. C. triundulatus, elongatus, niger, cinereo-sericeus, thorace convexo, latitudine non longiore, lateribus rotundatis, angulis posticis brevibus non carinatis, divaricatis, subtiliter dense punctato, subcanaliculato, elytris lateribus vix dilatatis, luteo-testaceis, fasciis tribus postice concavis subdenudatis fuscescentibus, striis punctulatis, interstitiis planis, dense punctulatis, antennarum articulo 3^tio^ sequenti breviore. Long. ·28—·35.

Elater triundulatus Randall, Bost. Journ. Nat. Hist. 2, 12.

Abundant at Lake Superior, and in Maine.

6. C. hieroglyphicus, crassiusculus, niger, cinereo-pubescens, thorace aureo-sericeo, dense subtiliter punctato, non transverso, lateribus late rotundatis, angulis posticis subtestaceis, elytris luteo-flavis, macula oblique humerali per suturam extensa, alteraque ad medium lunata per suturam fere ad apicem producta nigris, striis vix punctatis, interstitiis subconvexis, punctatis, antennis pedibusque rufis, illis extus fuscescentibus, articulo 3^tio^ 4to non breviore. Long. ·5.

Elater hieroglyphicus Say, Trans. Am. Phil. Soc. 6, 172.

Lake Superior, Ohio, Maine; not rare. The joints of the antennæ diminish slightly in length from the fourth, but the difference is not so obvious as in many of the following species. The black markings of the elytra are connected by their sutural extensions; in one specimen the oblique line from the humerus to the suture is wanting, although the sutural portion of the spot is as large as in the other specimens.

7. C. furcifer, niger, cinereo-pubescens, thorace latitudine longiore, subtiliter punctato, lateribus late rotundatis, angulis posticis subtestaceis, elytris luteo-testaceis, macula humerali obliqua per suturam extensa, alteraque lunata pone medium nigris, striis punctatis, interstitiis distincte punctatis, antennis pedibusque piceis, illis articulo 1mo testaceo. Long. ·32.

One specimen found at Eagle Harbour, Lake Superior. Marked like the preceding, but in size only equal to C. propola, from which it differs by the longer thorax, and more deeply striate and more distinctly punctured elytra. In form it is a little less dilated than any of the preceding species.

8. C. nubilus, crassiusculus, niger, cinereo-pubescens, thorace non transverso, lateribus rotundatis, subtilissime punctulato, angulis posticis testaceis, elytris lurido-testaceis, maculis 3 pone basin (una communi) rotundatis, alteraque utrinque pone medium lunata, nigricantibus, tenuiter striatis, interstitiis fere planis punctulatis, antennis pedibusque nigris. Long. ·35.

One specimen, collected in California by Mr. Child, and given me by Mr. Rathvon. The markings are on the same plan as those of the preceding species, but they are not dilated along the suture, and the anterior is broken up so as to form a rounded spot each side behind the humerus, and a larger less distinct one at the suture. The finer punctuation of the thorax, and the black feet, will enable it to be readily recognised.

9. C. inflatus, obesus, æneo-niger, cinereo-pubescens, fronte plana convexa, thorace convexo, dense subtilius punctato, subtransverso, lateribus antice rotundatis, elytris striis punctatis, interstitiis subconvexis, confertim punctulatis, antennis piceis basi rufescentibus, pedibus rufis. Long. ·33—·45.

Elater inflatus Say, Ann. Lyc. 1, 258; Trans. Am. Phil. Soc. 6, 174; Germ. Zeitschr. 4, 74.

Common in the Southern and Western States; rare in Pennsylvania. The interstices of the elytra vary, being sometimes almost flat, and sometimes distinctly convex. This species is properly attached to the first division, from the other species of which it differs only by the elytra being less broadly margined; the joints of the antennæ following the fourth are equal; and the fourth is hardly perceptibly longer than the fifth.

10. C. nitidulus, picco-æneus, tenuiter cinereo-pubescens, thorace convexiusculo, latitudine sublongiore, antrorsum subangustato, lateribus parum rotundatis, angulis posticis acutis productis, rufescentibus, minus dense subtiliter punctato, postice canaliculato, elytris striis impunctatis, interstitiis planis disperse punctulatis, antennis piceis basi pedibusque rufis. Long. ·35—·4.

Abundant at Lake Superior. Smaller and more slender than the next species; hardly dilated on the sides: it is easily distinguished by its convex, less rounded, and less densely punctured thorax.

11. C. aratus, crassiusculus, æneo-niger, tenuiter cinereo pubescens, thorace latitudine sublongiore, paulo convexo, lateribus antice rotundatis, angulis posticis acutis productis rufescentibus, postice profunde canaliculato, confertim, lateribus densius punctato, elytris striis tenuibus, punctatis, interstitiis præcipue planis, disperse punctulatis, pedibus rufis, antennis piceis. Long. ·43—·53.

Abundant at Lake Superior: smaller and more slender than the next species, hardly dilated on the sides: it is easily distinguished by its convex, less rounded and less densely punctured thorax.

11. C. a r a t u s, crassiusculus, æneo-niger, tenuiter cinereo-pubescens, thorace latitudine sublongiore, paulo convexo, lateribus antice rotundatis, angulis posticis acutis, productis, rufescentibus, postice profunde canaliculato, confertim, lateribus densius punctato, elytris striis tenuibus, punctatis, interstitiis præcipue planis, disperse punctulatis, pedibus rufis, antennis piceis. Long. ·43—·53.

Abundant at Lake Superior: closely resembles in form and characters C. splendens, but is distinctly pubescent, and a little more slender in its general form: the fourth joint of the antennæ is not longer than the fifth.

A —2.—a.

12. C. s p l e n d e n s, crassiusculus cupreo-æneus, vel brunneo-æneus, supra vix tenuissime pubescens, thorace paulo convexo, latitudine longiore, lateribus antice rotundatis, angulis posticis productis, rufescentibus, confertim lateribus confertissime punctato, elytris striis punctulatis, antennis nigris, pedibus prosternique lobo rufis. Long. ·4—·52.

Diacanthus splendens Ziegler, Proc. Acad. Nat. Sc. 2, 44.

Pennsylvania, Massachusetts, Lake Superior: it is Elater metallicus of Harris' catalogue. The epipleuræ are sometimes tinged with rufous. The specimens from Lake Superior usually have the thorax more densely punctured, but otherwise do not differ from those found nearer the Atlantic.

13. C. æ r i p e n n i s, crassiusculus, niger, supra glaberrimus, thorace minus convexo, latitudine sublongiore, lateribus late rotundatis, confertim punctato, angulis posticis elongatis, elytris viridi-æneis nitidis, striis punctatis, interstitiis minus dense punctulatis. Long. ·5—·58.

Aphotistus æripennis Kirby, Fauna Bor. Am. 150, (1837.)

Elater appropinquans Randall, Bost. Jour. Nat. Hist. 2, 5, (1838.)

Diacanthus æripennis Germ. Zeitschr. 4, 82.

Very abundant at Lake Superior: found by Randall in Maine. The elytra vary in colour, being sometimes almost coppery.

14. C. c a r b o, nigerrimus, supra glaber, thorace latitudine longiore, paulo convexo, dense lateribus confertissime punctato, antice angustato et lateribus rotundato, angulis posticis elongatis, elytris striis punctatis, interstitiis fere planis, punctulatis. Long. ·56.

One specimen from Oregon. Not so broad in its form as C. æripennis, but having, like that species, the fourth joint of the antennæ conspicuously longer than the fifth: it resembles very much the next, but the thorax is entirely black, and the dorsal line is very faint, and visible only near the base.

15. C. l a t e r a l i s, nigerrimus, supra glaber, thorace latitudine longiore, paulo convexo, dense lateribus sanguineis confertissime punctato, antice angustato et lateribus rotundato, angulis posticis productis, dorso acute canaliculato, elytris striis vix punctulatis, interstitiis fere planis punctulatis. Long. ·54.

One specimen, Oregon, Col. M'Call. The inflexed portion of the thorax, as well as a broad lateral margin, is sanguineous: the antennæ are as in the two preceding species.

16. C. coniungens, niger, parce griseo-pilosus, thorace canaliculato, latitudine longiore, antice angustato, convexiusculo, ante basin paulo latiore, lateribus late rotundatis, sat punctato, lateribus paulo densius, elytris lateribus vix dilatatis, apice vix oblique attenuatis, profunde striatis, striis punctatis, interstitiis subbiseriatim punctatis, antennis rufo-piceis, pedibus ferrugineis. Long. ·42.

One specimen, California, Mr. J. Child. This species at first seems similar to C. æthiops, but the joints of the antennæ are not broad and compressed, but are formed as in the preceding species: the third joint is considerably longer than the second, and a little longer than the fourth, so that it cannot be associated in the division with C. rotundicollis and C. sulcicollis, to which it forms a transition by its less dilated elytra.

17. C. pulcher, crassiusculus, vix tenuissime pubescens, niger, thorace quadrato, convexo, lateribus antice rotundatis, angulis postieis acutis paulo productis, confertim punctato, sanguineo, vitta dilatata dorsali margine prosternoque nigerrimis, elytris testaceis, sutura, macula elongata humerali, fasciaque pone medium transversa nigris, striis profundis punctulatis, interstitiis parce punctulatis, abdominis lateribus sanguineis. Long. ·53.

One specimen from New Hampshire in Dr. Harris' collection. It closely resembles Elater cruciatus *Linn.* of Europe, but differs (according to description) by the black feet and antennæ. This species might perhaps be more naturally placed in the preceding division near C. hieroglyphicus: the joints of the antennæ do not diminish in size after the fourth, as in the preceding species of this division: the fourth is, however, decidedly longer than the fifth.

A.—2.—6.

18. C. crassus, obesus, piceo-niger, vix tenuissime pubescens, fronte profunde concava, thorace transverso, inflato, lateribus antice rotundatis, apice fortius transversim impresso, minus dense punctato, elytris striis punctatis, interstitiis planis parcius punctatis, pedibus piceis. Long. ·55.

Kentucky, Dr. Harris; Pennsylvania, Dr. Melsheimer. The deep impression along the apical margin of the thorax is dilated at the angle, each side, and is a remarkable character. It is much more robust and inflated in its form than any other of our species.

A.—2.—5.

19. C. rotundicollis, angustatus, niger, glaber, thorace quadrato, latitudine paulo breviore, lateribus rotundato, angulis posticis parvis acutis divarieatis, convexo, parce subtilius punctato, (sæpe sanguineo,) elytris lateribus vix dilatatis, apice rotundatim attenuatis, striis profundis impunctatis, interstitiis vix punctulatis, pedibus nigris, tarsis fere testaceis. Long. ·41.

Elater rotundicollis Say, Ann. Lyc. 1, 259, (var. thor. sanguineo.)

Vermont, Prof. Adams. The black variety is from Pennsylvania, and was given me by Rev. D. Ziegler. The remarkably rounded, quadrate thorax, with small, sharp, diverging angles, will distinguish this from any other native species. It differs from all the preceding by the more parallel elytra, which behind the middle are not obliquely narrowed, but regularly rounded. The fourth joint of the antennæ, although longer than the following, is not so much so as in the species just described: the antennæ are hardly serrate, so that the fourth and following joints are very little wider than the third.

Diacanthus sticticus and russicollis, Germ. (Zeitschr., 4, 74,) seem to be closely related to this species, but must be different: the former has the thorax slightly rounded on the sides; the latter has the thorax and feet rufous, and the thorax strongly rounded on the sides.

Elater rubricollis Say, (Journ. Acad. 3, 177,) quoted by Germar, under his D. russicollis, is in reality Herbst's species of the same name, and will be found under Elater rubricollis of the present essay.

20. C. sulcicollis, elongatus, parallelus, nigro-piceus, glaber, thorace antice sublatiore latitudine fere sesqui longiore, lateribus rectis, apice breviter rotundatis, minus convexo, confertim punctato, profunde canaliculato, angulis posticis acutis, elytris apice rotundatim attenuatis, striis punctatis, interstitiis modice convexis, punctulatis, epipleuris pedibusque piceo-rufis. Long. ·55—·6.

Elater parallelus ‖ Say, Ann. Lyc. 1, 256.

Elater sulcicollis Say, Trans. Am. Phil. Soc. 6, 168.

Middle and Southern States, rare. The joints of the antennæ are moderately dilated and diminish gradually in length from the fourth.

A.—3.

21. C. nubilipennis, elongatus linearis, vix pallide pubescens, niger, fronte subconcava, thorace latitudine longiore, antrorsum vix angustato, lateribus paulo rotundatis, minus dense punctato, postice canaliculato, elytris parallelis, striis punctatis, interstitiis disperse punctulatis, testaceis pone basin et ad medium infuscatis. Long. ·34.

One specimen from Oregon, Col. M'Call. The posterior angles of the thorax are long and acute; the third joint of the antennæ is equal in length to the fourth, but is not at all dilated. The last joint is wanting, so that we cannot be certain that it belongs to this division; its general appearance, however, prevents it from being placed in any other. The front is slightly concave, not showing the quadrate outline which may be perceived in the others of this group.

22. C. æratius, elongatus, supra glaber, splendide viridiaureus, thorace latitudine longiore, antrorsum subangustato, lateribus late rotundatis, sat dense lateribus confertim punctato, cupreo-marginato, postice subcanaliculato, elytris striis punctatis, interstitiis parce subtiliter punctulatis, antennis nigris, articulo 3° non dilatato. Long. ·45—·56.

Elater æratius Randall, Bost. Journ. Nat. Hist. 2, 7.

Elater (diacanthus) Racinei Chevrolat, Rev. et Mag. de Zoologie, 1852.

Lake Superior, Maine, Newfoundland. This must be very similar to C. resplendens, (Germ. Zeitschr. 4, 60,) which, however, must have the third joint of the antennæ dilated. In my catalogue of Lake Superior Coleoptera, I have placed them as synonymous, but, until comparisons are made, they must be considered as distinct. The front in this species is not slightly concave as in the preceding, but flattened, not quite so straight along the anterior part, where the declivity commences, as in the next two species, but showing a tendency to become quadrangular; the antennæ of both sexes are strongly serrate.

Varieties occur of a golden copper, and also of a bluish green colour.

23. C. furtivus, elongatus, linearis, æneo-piceus, cinereo-pubescens, thorace latitudine longiore, antrorsum vix angustato, lateribus rotundatis, punctato, postice profunde canaliculato, elytris striis punctulatis, interstitiis fere planis, sat dense punctulatis, pedibus piceis. Long. ·45.

One male specimen, Oregon. This species exactly resembles C. appressifrons in appearance; the third joint of the antennæ, however, is not dilated, and the elytra are slightly obliquely attenuated behind the middle; the front is almost flat, and the declivity commences along a straight line, which gives a quadrate appearance to the front, and indicates an osculation with Limonius.

24. C. atropurpureus, elongatus, linearis, cupreo-piceus, cinereo-pubescens, thorace latitudine longiore, convexo antice angustato, lateribus postice subrectis, antice rotundatis, sat dense punctato, canaliculato, elytris striis vix punctulatis, interstitiis planiusculis parce punctulatis, epipleuris pedibusque rufis, antennis piceis. Long. ·44.

Melsheimer, Proc. Acad. Nat. Sc. 2, 215.

I have only seen the typical female specimen in Dr. Melsheimer's collection; it was found in Pennsylvania. The antennæ are hardly as long as the thorax, and the third joint is not at all dilated. The front is as in the preceding species.

A.—4.

25. C. appressifrons, piceus, obsolete æneseens, cinereo-pubescens, cylindricus, postice obtusus, thorace latitudine longiore, antice non angustato, lateribus fere rectis, angulis posticis acutis divaricatis, sat punctato, postice canaliculato, elytris striis acutis, punctulatis, interstitiis fere planis punctatis, epipleuris pedibusque rufo-piceis.

Mas, thorace latitudine fere sesqui longiore, modice convexo: antennis thorace longioribus. Long. ·45—·5.

Elater appressifrons Say, Ann. Lyc. 1, 267; Harris, Insects Injurious to Vegetation, 1st, 49; 2d, 48.

Corymbetes cylindriformis ‡ Germ. Zeitschr. 4, 64.

Femina, thorace latitudine paulo longiore, magis convexo: angulis posticis minus productis; antennis thorace brevioribus. Long. ·6—·72.

Elater brevicornis Say, Ann. Lyc. 1, 265.

Corymbetes parallelopipedus Germ. Zeitschr. 4, 66.

Middle States, abundant. We are indebted to Dr. Harris for the discovery of the interesting difference in form, in the sexes of this species.

For the reasons upon which I refuse to adopt Germar's opinion, that this is the Elater cylindriformis *Herbst*, see the remarks under Limonius cylindriformis.

A.—5.

26. C. obscurus, ater, subtiliter nigro-pubescens, subparallelus, fronte concava thorace latitudine non longiore, antrorsum vix angustato, lateribus late rotundatis angulis posticis brevissculis, parum convexo, confertim punctato, linea dorsali vix conspicua lævi, elytris pone medium subattenuatis, striis tenuibus, interstitiis fere planis confertim punctulatis. Long. ·46.

One specimen, California, Mr. Pease. Body moderately elongated, not dilated on the sides, black, not very shining, finely pubescent with grayish black hair; head broadly concave, punctured; thorax not longer than wide, slightly convex, densely punctured,

especially at the sides, with a hardly perceptible smooth not impressed dorsal line; sides broadly rounded, posterior angles short, truncate, slightly divergent. Elytra not wider than the thorax, very slightly obliquely attenuated behind the middle; striæ fine, well impressed; interstices tolerably densely, finely punctured. Legs and antennæ entirely black; the latter as in the male of C. appressifrons, with the joints triangular, not produced at the angle; the third joint a little smaller than the fourth; the eleventh elongated, deeply constricted.

27. C. cribrosus, ater, breviter nigro-pubescens, subparallelus, fronte concava, thorace latitudine longiore, lateribus late rotundato, antrorsum vix angustato, canaliculato, grossius, lateribus dense punctato, angulis posticis acutis subdivergentibus, elytris striis punctulatis, interstitiis punctatis et rugosis, fere scabris. Long. ·54.

California, San Francisco. The antennæ are much more strongly serrate than in any of the preceding species; the joints are decidedly broader than long, and somewhat produced externally; the third joint is smaller than the fourth, and the eleventh is constricted. The elytra are very slightly obliquely attenuated behind the middle.

28. C. signaticollis, niger, nitidus, supra glaber, subparallelus, fronte concava, thorace latitudine longiore, parce grossius punctato, antrorsum vix angustato, lateribus late rotundatis, late rufo, vitta dorsali lata, angulisque posticis divergentibus nigris: elytris striis punctatis profundis, interstitiis vix punctulatis, pedibus piceis. Long. ·33.

Diacanthus? signaticollis Melsheimer, Proc. Acad. Nat. Sc. 2, 216.

Middle and Southern States, not common. The antennæ of this species are very strongly serrate, the joints not transverse, with the outer angle produced; the third is somewhat smaller than the fourth; the eleventh constricted. The prosternum is entirely black, the inflexed portion of the prothorax is red, becoming black towards the sternum.

29. C. trivittatus, ferrugineus, cinereo-pubescens, subparallelus, capite nigro, concavo, thorace latitudine sublongiore, antrorsum mollice angustato, lateribus rotundatis, angulis posticis acutis divergentibus, maculaque magna dorsali nigris, sat dense punctato, leviter canaliculato, elytris flavo-testaceis, sutura vittaque discoidali, sæpe ante medium interrupta nigris, striis irregulariter, interstitiis vage punctatis, tarsis piceis, antennis nigris articulo 3° sequenti multo minore, vix triangulari. Long. ·46—·68.

Abundant in the upper portions of the Southern States; sent me by Zimmermann, as Pristilophus 3-vittatus Germ. MSS. This species is of difficult location, but from its concave front, narrow form, and strongly serrate antennæ, it seems most naturally placed in the present division, forming the transition from those having the third joint of the antennæ dilated, to the two following, in which it is almost cylindrical. The pubescence of the under surface is silvery, and the sutures of the pectus are blackish; the last joint of the antennæ is strongly constricted.

30. C. æthiops, niger, tenuissime cinereo-pubescens, subparallelus, postice magis angustatus, fronte concava, thorace latitudine longiore antrorsum subangustato, lateribus late rotundato, canaliculato, punctato, densius ad latera, elytris striis punctatis, interstitiis vage punctatis, antennis articulo 3° sequenti non breviore, vix dilatato. Long. ·53—·83.

Elater æthiops Herbst, Käfer, 10, 70; tab. 164, fig. 1.

Pristilophus æthiops Germ. Zeitschr. 4, 86.

Middle States, not rare. The tarsi are somewhat more densely pubescent than usual, but by no means brush-like beneath, as in the large species with prominent mesosternum, placed by Germar in the same genus with this species, but which I have removed under the name Melanactes.

31. C. maurus, ater, minus nitidus, tenuissime fusco-pubescens, subparallelus, fronte concava, thorace latitudine longiore, lateribus postice parallelis antice rotundatis, angulis posticis acutis divergentibus, leviter canaliculato, dense, lateribus confluenter punctato, elytris striis punctatis, interstitiis fere planis sat dense punctatis et rugosis, antennarum articulo 3^io^ subdilatato, 4to non breviore. Long. ·63.

Oregon, Col. M'Call. Sufficiently distinct from any other species herein described, and apparently more nearly related to C. æthiops; the third joint of the antennæ is triangular, as long, but only half as wide as the following, which are acutely triangular, but not produced at the angle; the eleventh joint is not longer than the tenth, not acuminate, but still distinctly constricted.

A.—6*.—a.

32. C. vernalis, ater, tenuiter fusco-pubescens, thorace latitudine longiore, antrorsum angustato, lateribus rotundatis, subtiliter punctato, angulis posticis divergentibus, elytris læte flavis, macula scutellari, alterisque utrinque duabus subrotundatis nigris, striis punctatis, interstitiis subtilissime punctulatis, fere planis, antennæ maxime serratis, articulo 3^io^ sequenti non minore. Long. ·28.

Germar, Zeitschr. 4, 56.

Elater vernalis Hentz, J. Ac. Nat. Sc. 5, 374; tab. 13, fig. 2: Say, Tr. Am. Phil. Soc. 6, 172.

Middle, Southern, and Western States, rare. The third joint of the antennæ is not smaller than the fourth, but its outer angle is not produced.

33. C. Kendalli, nigro-cupreus, tenuiter cinereo-pubescens, thorace latitudine vix longiore, antrorsum angustato, lateribus rotundato, angulis posticis acutis divergentibus, convexo, profunde et late canaliculato, punctato densius ad latera, elytris luteo-testaceis, striis punctulatis, interstitiis fere planis, subtilius punctatis, plaga elongata versus apicem suturaque purpurascentibus, antennis articulo 3^io^ sequenti non minore. Long. ·6.

Germar, Zeitschr. 4, 57.

Ctenicerus Kendalli Kirby, Fauna Bor. Amer. 149; tab. 2, fig. 7, (1837.)

Elator anchorago Randall, Bost. Journ. Nat. Hist. 2, 5, (1838.)

One specimen, found on the north shore of Lake Superior. Mr. Randall found it in Maine: Kirby's specimen was found in lat. 65°. The thorax is so deeply and broadly channelled that the disc appears longitudinally elevated each side: the antennæ of the male are pectinate.

34. C. cuprascens, æneo-cupreus, æqualiter cinereo-pubescens, thorace latitudine sublongiore, antrorsum angustato, lateribus rotundato, angulis posticis elongatis, divergentibus, canaliculato, punctato, densius ad latera, elytris striis punctulatis, interstitiis planis confertim subtilius punctulatis, pedibus rufis, antennis piceis, basi rufescentibus, articulo 3^io^ sequenti paulo minore, 11mo non constricto. Long. ·63.

One specimen, Saratoga, Mr. James Thomson. Very similar to the next, but is more robust than the female of that species: the principal differences are that the antennæ have

not the last joint constricted, and that the pubescence of the upper surface is uniformly distributed.

35. C. micans, æneo-cupreus, cinereo-pubescens, thorace latitudine longiore, antrorsum subangustato, lateribus antice rotundatis, angulis posticis elongatis divergentibus, subcanaliculato, punctato densius ad latera, elytris striis punctulatis, interstitiis planis confertim subtilius punctulatis, spatiis transversis denudatis subfasciatis, antennis piceis vel nigris, articulo 3° sequente vix minore, 11mo constricto. Long. ·5—·6.

Germar, Zeitschr. 4, 62.

New York and New England. In the female the antennæ are shorter than the thorax, and the elytra behind the middle are more suddenly narrowed to the apex.

A.—6*.—8.

36. C. tarsalis, elongatus, æneo-niger, vix nitidus, tenuiter fusco-pubescens, thorace latitudine fere sesqui longiore, antrorsum subangustato, lateribus vix late rotundatis, angulis posticis productis, vix obsolete carinatis, minus convexo, confertim lateribus confertissime punctato, elytris luteis, sutura nigricante, striis punctatis, interstitiis subconvexis, dense punctulatis, pedibus testaceis, antennis nigris articulo 3^io^ sequenti fere æquali, 11mo constricto. Long. ·43.

Athous tarsalis Melsheimer Proc. Acad. Nat. Sc. 2, 157.

Massachusetts to Maryland, not common. It is the *Elater suturalis*, Harris' Cat., according to a specimen communicated to me by Dr. Harris. Dr. Melsheimer describes his specimen as having black tarsi, but on examination I find that they are only fuscous: in most specimens they are no darker than the tibiæ. In his specimen, as in Dr. Harris', there is an oblong fovea at the apex of the clypeus, which, however, is wanting in my specimens. There can be no doubt about the generic position of this species; it only differs from the neighbouring species in having the carina of the posterior thoracic angles less distinct.

A variety in Dr. Harris' collection, from New Hampshire, is a little more lustrous, and has the interstices of the elytra less densely punctulate.

37. C. telum, valde elongatus, linearis, fusco-niger, subæneus, tenuiter cinereo-pubescens, thorace latitudine sesqui longiore, antrorsum vix angustato, lateribus rectis, angulis posticis valde divergentibus non carinatis, confertim lateribus confertissime punctato, elytris tenuiter striatis, interstitiis confertissime rugosis, pedibus fusco-piceis, antennis elongatis, nigerrimis. Long. ·4.

One specimen, Oregon. Although having the same structure of antennæ, and the same sculpture of thorax, as the preceding, this species, by its form, approaches very closely to the species of a subsequent division, containing C. pyrrhos: the triangular joints of the antennæ, and the slightly convex front, require it to be placed in this division.

A.—6**.

38. C. semilucens, ater, tenuiter fusco-pubescens, thorace latitudine longiore, lateribus postice parallelis, ante medium rotundatis, confertim subtilius punctato, linea dorsali tenui lævi parum convexo, angulis posticis non divergentibus, elytris minus convexis fortius marginatis luteo-testaceis, antice parallelis pone medium oblique attenuatis, striis subtiliter punctatis, interstitiis confertissime punctulatis, antennarum articulo 3° sequenti æquali. Long. ·18.

One specimen, California, collected by Mr. Child. This species with the following establishes a passage to C. rubidipennis and others above described: the sides of the elytra are however less dilated, so as not to alter the regular outline of the anterior portion; the antennæ are also more compressed, and the third joint is fully as large as the following ones: the last joint is wanting, but is probably not constricted.

39. C. fallax, ater, cinereo-sericeus, thorace latitudine sublongiore, antrorsum angustato, lateribus rotundatis, angulis posticis brevibus divaricatis apice obtusiusculis, confertim punctato, postice subcanaliculato, elytris piceo-testaceis tenuiter striatis, interstitiis confertissime subtiliter punctulatis fasciis duabus subdenudatis notatis, fortius marginatis, pone medium oblique attenuatis, pedibus testaceis femoribus obscurioribus, antennis nigris, articulo 3^io^ sequente non breviore, parum dilatato. Long. ·42.

Elater fallax Say, Trans. Am. Phil. Soc. 6, 170.

One specimen, Lake Superior, Dr. Harris has found it in New Hampshire. This species completes the connexion with the species in the first group of the genus: in addition to the obliquely attenuated and broadly margined elytra, the third joint of the antennæ is only half as wide as the fourth: the last joint is not constricted. The bands on the elytra are produced by the hairs being placed in a different direction, so as not to reflect the light when the other portions show a sericeous lustre.

40. C. divaricatus, fusco-piceus, breviter griseo-pubescens, fronte paulo concava, thorace parum convexo, latitudine sublongiore antrorsum paulo angustato, lateribus omnino rectis apice subito inflexis, angulis posticis elongatis divaricatis, confertim sat grosse punctato, canaliculato, elytris pone medium oblique attenuatis, plus minusve fusco-testaceis, striis punctatis vix impressis, interstitiis subtilius punctatis, antennis articulo 3^io^ 4to æquali, 11mo vix constricto. Long. ·37—·45.

Georgia and Carolina, abundant. This species will be easily distinguished by the long divergent posterior angles of the thorax, and the straight sides which are inflexed suddenly at the apex, so that the anterior angles become rounded: the apex is transversely impressed and excavated each side as in a few other species. The elytra are usually brownish, but are sometimes as dark as the thorax.

40. C. appressus, latiusculus, niger, supra glaber, thorace latitudine breviore, antrorsum angustato, lateribus late rotundatis, angulis posticis productis subdivergentibus, obsolete carinatis, apice lateribusque postice latioribus læte rufis, confertim subtiliter punctato, elytris postice suboblique attenuatis, fortius marginatis, læte flavis, sutura antice latiore, macula oblonga humerali, lineaque pone medium nigerrimis, striis vix punctatis, interstitiis planis punctulatis, tibiis basi testaceis, antennis nigris, articulo 3^io^ 4to æquali, 11mo vix constricto. Long. ·4.

Elater appressus Randall, Bost. Journ. Nat. Hist. 2, 11.

Corymbites mirificus Le Conte, Agass. Lake Sup. 228.

One specimen, Lake Superior; Randall found it in Maine. By its shorter thorax and broader form, this species is remarkably different from all the other species here described, in which the third joint of the antennæ is dilated; but by the more distinctly margined elytra it shows an affinity to the two preceding species. The under surface is black, with the exception of the inflexed margin of the prothorax, which is red, with a large discoidal black spot; the black line of the elytra is connected with some indistinct black marks about the middle, which in some specimens may form a transverse fascia.

A.—7.

42. C. spinosus, modice elongatus, picco-niger, tenuiter cinereo-pubescens, thorace latitudine longiore, parum convexo, antrorsum subangustato, lateribus late rotundatis, confertim subtiliter punctato, angulis posticis elongatis, subtestaceis, elytris picco-testaceis, pone medium suboblique angustatis, dense punctatis, obsolete striatis, pedibus piceis, antennis nigris, articulis elongatis, 3us sequenti non angustiore. Long. ·48—·62.

Lake Superior, not rare. This species is an osculant between this division from which it borrows the slender subquadrate antennal joints, and the first division, to which it approaches by the somewhat obliquely attenuated elytra; the elytra are, however, not strongly margined, and possibly a nearer approach is made to C. tarsalis, of the preceding division. The posterior angles of the thorax are finely and strongly carinate, and the carina is parallel to the lateral margin. The sides of the thorax are more rounded in the female than in the male, and the thorax is less narrowed in front; the antennæ of the female are hardly longer than the thorax, those of the male are nearly half as long as the body.

43. C. pyrrhos, valde elongatus, linearis, fusco-testaceus, vel fuscus pubescens, fronte subconcava, thorace latitudine plus sesqui longiore, subconvexo, confertim punctato, linea tenui dorsali lævi, angulis posticis elongatis, divaricatis, elytris striis punctatis, interstitiis vage punctatis, vix convexis, abdomine, pedibus, antennisque flavo-testaceis, his articulo 3us sequenti æquali. Long. ·67—·81.

Mas, thorace lateribus fere rectis, elytris postice haud oblique attenuatis; antennis valde elongatis.

· *Elater pyrrhos* Herbst, Käfer, 10, 30; tab. 160, fig. 11: Say, Trans. Am. Phil. Soc. 6, 186.

Femina, thorace lateribus obtuse subangulatis, elytris paulo dilatatis et oblique attenuatis.

Athous pyrrhicus Hald. Proc. Acad. Nat. Sc. 1, 303.

Athous vagrans Melsheimer, Proc. Acad. Nat. Sc. 2, 153.

Athous æqualis Melsheimer, Proc. Acad. Nat. Sc. 2, 153.

Middle, Southern, and Western States, not rare. Although placed in Athous by many authors, this species does not differ in any respect from Corymbites; the first joint of the tarsi is not as long as the two following, nor is the front margined anteriorly.

44. C. bivittatus, valde elongatus, linearis, nigro-piceus, fusco-pubescens, fronte concava, thorace latitudine plus sesqui longiore, antrorsum paulo angustato, lateribus rectis, angulis posticis elongatis testaceis, scabro-punctato, margine apicali, lineaque dorsali sæpe obsoleta testaceis, elytris testaceis, sutura, vitta dorsali margineque plus minus nigro-piceis, striis punctatis, interstitiis planis scabris, antennis piceis vel fuscis articulo 3us sequente paulo breviore. Long. ·32—·42.

Campylus? bivittatus Melsheimer, Proc. Acad. Nat. Sc. 2, 219.

Middle, Southern, and Western States. A variety found in New Jersey by Mr. Gnex, has the elytra luteous with the exception of a narrow black sutural and marginal line; another from Illinois has the thorax testaceous, with two broad dorsal vittæ, and a narrow marginal line blackish. The feet are sometimes piceous, sometimes testaceous. The antennæ are half as long as the body in my specimens, all of which appear to be males.

45. C. iaculus, valde elongatus, linearis, fusco-piceus, fusco-pubescens, fronte valde concava, antice submarginata, thorace latitudine plus sesqui longiore, lateribus rectis parallelis, apice paulo rotundatis, confertim punctato, angulis posticis divergentibus, productis, elytris striis punctatis, interstitiis subconvexis, rugose punctulatis, pedibus picco-testaceis, antennis articulo 3us sequente vix minore. Long. ·45.

Two specimens, San Diego, California. Although differing slightly in the form of the front, and in the smaller size of the fourth tarsal joint, this species is so exact a miniature of C. pyrrhos, that it cannot be separated as a distinct genus.

Body dark fuscous, covered with fine short brownish gray hair; head densely punctured, deeply concave, with the lateral margins indistinctly uniting at tip; eyes prominent. Antennæ half as long as the body, second joint small; the following ones compressed, elongate, very slightly triangular, the third not quite as long as the fourth, the eleventh hardly acuminate. Thorax more than one-half longer than wide, sides straight, except at the apex, where they are very slightly rounded; posterior angles elongate, acute, slightly diverging, carina sharp, near the lateral margin; disc densely and coarsely punctured; elytra parallel, rounded posteriorly, striæ fine, subpunctulate, interstices very slightly convex, rugosely punctulate, especially near the striæ; beneath somewhat paler, legs almost testaceous, tarsi with the first joint decidedly longer than the second, and with the fourth joint one-half as long as the third.

B.

46. C. insidiosus, æneo-niger, longiusculus, cinereo-pubescens, thorace minus convexo, angulis anticis foveatis, quadrato, lateribus parallelis antice rotundatis, angulis posticis angustis, acutis carinatis divergentibus, minus dense punctulato, subcanaliculato, elytris densius punctatis, testaceis, obsolete striatis, antennis vix serratis piceis, articulis 2 et 3 æqualibus sequente coniunctis longioribus, ano pedibusque fusco-testaceis. Long. ·45.

Lake Superior, rare. A very easily distinguished species, of a somewhat elongate form, with the elytra slightly obliquely attenuated behind the middle. The first joint of the tarsi is hardly longer than the second.

47. C. falsificus, æneo-niger, elongatus cinereo-pubescens, thorace latitudine longiore, convexiusculo, lateribus rectis parallelis apice rotundatis, angulis posticis parvis divaricatis non carinatis, subtestaceis, disco subtiliter punctato, subcanaliculato, elytris testaceis, tenuiter striatis, interstitiis dense punctatis, sutura infuscata, pedibus testaceis, antennis piceis, vix serratis, basi testaceis, articulis 2 et 3 æqualibus coniunctis 4to longioribus. Long. ·3—·35.

In form closely resembles the preceding, but the smaller size and non-carinated angles of the thorax distinguish it: the thorax at the apex is indistinctly margined, and somewhat impressed near the angles: the first joint of the tarsi is conspicuously longer than the others.

In case the small spongy tuft at the tip of the tarsal joints should not be considered of sufficient importance to warrant the grouping of the species here adopted, the natural position of this and the preceding species would be in Div. (2,) in the same group with C. inflatus, forming the transition between that in C. rotundicollis.

48. C. mendax, picco-æneus, elongatus, cinereo-pubescens, thorace latitudine longiore, convexo, ad apicem utrinque transversim impresso, lateribus ante medium rotundatis, angulis posticis carinatis divergentibus, confertim punctato, subcanaliculato, elytris striis punctatis, interstitiis planis rugose punctulatis, antennis nigris, vix serratis, articulo 3to 2^ndo^ paulo longiore, coniunctis 4to longioribus, pedibus piceis. Long. ·41.

One specimen, Lake Superior: has the appearance of Limonius, but the front is not

margined anteriorly, and not quadrate: its real affinities are with the two preceding species, from which it differs by its more convex and coarsely punctured thorax. The elytra are somewhat obliquely narrowed posteriorly, and more strongly margined than in the two preceding. The first joint of the tarsi is not longer than the second.

49. C. angularis, nigro-piceus, valde elongatus, tenuiter pubescens, thorace latitudine fere sesqui longiore, antice non angustato, parum convexo, lateribus fere rectis, apice submarginato, angulis anticis rufescentibus latius marginatis, angulis posticis acutis divaricatis, setaceis, carina margini valde approximata, confertim punctato, elytris striis punctulatis, interstitiis rugose-punctulatis, pedibus piceis, antennis nigris, basi piceis, subserratis, articulo 3° 4° non breviore, subcylindrico. Long. .35.

One specimen, Oregon. Although evidently allied to the others in this division, the third joint of the antennæ is considerably narrower than the following ones: the curious reflexed margin of the anterior thoracic angles will easily distinguish this species: the sides of the thorax are almost straight, slightly rounded at the apex, and before the basal angles: the first joint of the tarsi is slightly longer than the second.

Asaphes *Kirby.*

Although but one species of this genus is described by Kirby and another by Germar, I find several of our Elaters possess characters which require them to be associated with his type. They seem to form a natural group approaching most nearly to Corymbites, and indeed differing from that genus only in the structure of the tarsi. The second and third joints of the tarsi are dilated beneath into a short spongy lobe: the first joint is as long as the second and third together, and usually spongy at the tip: the fourth joint is small and narrow, received upon the third, and is sometimes also spongy beneath: the fifth joint is elongate with simple claws.

Our species may be grouped according to the presence or absence of the basal fissures and carinæ of the thorax. The third joint of the antennæ is more or less dilated and usually but little smaller than the fourth. The first group osculates with Corymbites: the second with Athous and Pedetes.

A. *Thorax fissuris basalibus distinctis; angulis posticis carinatis.*

1. A. hemipodus, crassus, nigro-piceus, subæneescens, tenuiter grisco-pubescens, thorace subtransverso valde convexo, transversim subcorrugato, modice punctato, densius ad latera, lateribus rotundatis, angulis posticis parvis divergentibus, elytris ad medium latioribus, dein oblique angustatis, striis punctulatis, interstitiis vage punctatis, pedibus obscure rufis. Long. .61.

Elater hemipodus Say, Ann. Lyc. 1, 251: Trans. Am. Phil. Soc. 6, 176.

One specimen, Maryland, Prof. Adams: a curious robust species which exhibits a wonderful resemblance to Corymbites crassus above described. The transverse wrinkles of the thorax are not mentioned by Say, and are possibly not constant. The elytra have four broad faint impressions, producing a slight elevation about the middle, nearer to the side than to the suture: the third joint of the antennæ appears to be about the same size as the fourth, and hardly narrower.

2. A. memnonius, atro-fuscus, fusco-pubescens, thorace non transverso, antice vix angustato dense punctato, linea lævi dorsali vix distincta postice impressa, angulis posticis parvis non divergentibus, elytris confertim punctatis, striis distincte punctatis, antennis pedibusque piceo-rufis. Long. ·63—·82.

Elater nemnonius (err. typ.) Herbst, Käfer, 10, 29, tab. 160, fig. 10: Say, Trans. Am. Phil. Soc. 6, 176.

Pedetes (Asaphes) ruficornis Kirby, Fauna Bor. Am. 146.

Maine, Ohio, Pennsylvania, Alabama. The thorax of the female is more convex than the male, and more rounded on the sides. The interstices of the elytra are usually slightly convex, but one individual from Mr. Guex has them entirely flat. The carinæ of the posterior angles of the thorax are parallel with the margin and very strongly marked.

3. A. baridius, nigro-fuscus, fusco-pubescens, thorace subtransverso, antice angustato, lateribus ante medium valde rotundatis, dense punctato, linea dorsali postice subimpressa, angulis posticis non divaricatis, elytris striis punctatis, interstitiis subconvexis confertim punctatis, antennis pedibusque rufo-piceis. Long. ·90.

Elater baridius Say, Trans. Am. Phil. Soc. 6, 176.

Hemicrepidius Thomasi Germ. Zeitschr. 1, 213.

Maine to Georgia. I was at first inclined to believe this merely a variety of the preceding, but as the difference in the form of the thorax cannot be altogether sexual, they must be considered as distinct: the carinæ of the posterior angles of the thorax, as in the preceding, are very strong and parallel with the margin.

4. A. morio, niger, nitidus, parce pubescens, thorace latitudine non longiore parce punctato, postice canaliculato, angulis posticis non divergentibus, carina divergente, elytris striis profundis punctatis, interstitiis subconvexis, minus dense punctulatis. Long. ·70.

One female, Oregon, Col. M'Call: the sides of the thorax are broadly rounded before the middle. This species has the robust form of A. memnonius, but the thorax is quite finely and thinly punctured at the middle, and more coarsely and densely at the sides: the carinæ of the posterior angles of the thorax are not parallel with the sides. The striæ of the elytra are more strongly punctured before the middle, and the outer striæ are deeper than those towards the suture: the interstices are moderately convex, finely not densely punctulate; from each puncture proceeds a short blackish hair, forming an indistinct pubescence.

5. A. aereus, elongatus, nigro-piceus, æneseens, cinereo-pubeseens, fronte paulo concava, thorace subtilius punctato, densius et subtilius versus latera, latitudine longiore, angulis posticis subdivaricatis, elytris striis punctatis, interstitiis subconvexis, punctatis, pedibus rufis vel piceis, antennis nigro-piceis, articulo 3^io^ modice dilatato. Long. ·43—·45.

Athous æreus Melsheimer, Proc. Acad. Nat. Sc. 2, 156. (♀)

Athous æneolus Melsheimer, Proc. Acad. Nat. Sc. 2, 156. (♂)

Middle and Southern States. The male resembles very much in appearance Corymbites appressifrons: the sides of the thorax are very slightly rounded, and the third joint of the antennæ, though narrower, is as long as the fourth. The female has the thorax narrowed and rounded before the middle, and the third joint of the antennæ about two-thirds

the length of the fourth. The front is slightly concave as in all the preceding species, a character which with the finer and denser punctuation of the thorax and prosternum, will readily distinguish this from the next species. The legs seem subject to variation in colour: sometimes they are bright testaceous yellow, and sometimes very dark piceous. A typical specimen of Athous æneolus furnished me by Dr. Melsheimer is a male of the variety with dark legs.

6. A. decoloratus, picco-niger, elongatus, cinereo-pubescens, fronte plana, non concava, thorace convexiusculo, latitudine longiore, subtiliter punctato, angulis posticis subdivergentibus, elytris (sæpe testaceis) striis profundis vix punctatis, interstitiis subconvexis, parce subtiliter punctulatis, antennis (basi sæpe rufis) articulo 3^io^ vix dilatato, 4to paulo breviore, pedibus vel testaceis vel nigris. Long. ·35—·5.

Elater decoloratus Say, Trans. Am. Phil. Soc. 6, 180.

Middle, Eastern, and Western States. Distinguished from the preceding by the punctuation of the thorax being more distinct, the thorax itself less convex, and the front not concave, although marked with two faint impressions; the third joint of the antennæ appears less dilated: in the male it is as long as the fourth; in the female somewhat shorter; the sides of the thorax are almost straight in the male, while in the female they are rounded before the middle. Among the specimens in my collection are three well marked types, which, however, are not sufficiently distinct to stand as species:

α. Corpus nigrum, elytris testaceis, pedibus testaceis, vel fusco-testaceis. (*El. dec.* Say.)
β. Corpus nigrum, pedibus, antennisque basi flavo-testaceis. (*El. xanthopus* + Harris.)
γ. Corpus nigrum, antennis pedibusque nigro-piceis.

Of the first variety, the base of the antennæ is sometimes almost testaceous; of variety (β) I have seen only females, and of (γ) only males.

7. A. indistinctus, picco-niger, elongatus cinereo-pubescens, fronte concava, thorace latitudine longiore, subtiliter, medio fere obsolete punctato, angulis posticis subdivergentibus, elytris striis punctatis, interstitiis fere planis, subtiliter parce punctulatis, pedibus testaceis, antennis articulo 3^io^ non dilatato (feminæ 2^ndo^ vix longiore.) Long. ·45.

One specimen, Georgia, with the thorax moderately convex, and the sides rounded before the middle. Easily distinguished from any of the varieties of the two preceding species, by the finer and more distant punctures of the thorax, and the more concave front.

B. *Thorax fissuris basalibus nullis, angulis posticis non carinatis.*

8. A. melanophthalmus, castaneus, vel rufo-piceus, helvo-pubescens, thorace confertim punctato, latitudine longiore, ante basin paulo latiore, angulis posticis parvis acutis, obsolete canaliculato, elytris striis antice punctatis, interstitiis planis minus dense punctatis, pedibus pallidioribus, antennarum articulo ultimo constricto. Long. ·6—·7.

Athous melanophthalmus Melsheimer, Proc. Acad. Nat. Sc. 2, 154.

Middle States, rare; as in the other species of this division, the front is slightly concave. This and the following species are so closely related, that it is very difficult to point out sufficient characters to distinguish them: the differences in the shape of the thorax in the sexes of the same species, also complicate the subject, as the precise sexual

relations are not known in all the species. I have endeavoured to point out such distinctive characters as appear to be independent of sex, but am very doubtful about the correctness of the results; although the differences of the posterior thoracic angles, the striæ of the elytra, and the constriction of the last joint of the antennæ are very considerable, yet until the sexual relations are fully understood, no great confidence can be felt in such characters, where the external appearance is so uniform.

This supposed species has the posterior angles of the thorax very small, not at all divergent, and acute; the sides of the thorax are broadly rounded, more so in (the female?) one sex than in the other; the last joint of the antennæ is strongly constricted and acuminate. The colour varies from dark reddish brown to castaneous; the pectus is sometimes darker than the abdomen; the feet are paler.

9. A. tener, valde elongatus, rufo-castaneus, helvo-pubescens, thorace elongato, antrorsum subangustato, lateribus rectis, confertim punctato, minus convexo, angulis posticis acutis, paulo productis, non divergentibus, elytris striis antice subtiliter punctatis, interstitiis fere planis, punctatis, antennis articulo ultimo non constricto. Long. ·60.

One specimen, New York; possibly the true male of the preceding; the angles of the thorax, though longer are still acute; the sides are straight, except at the very apex, where they are slightly rounded; the dorsal line is visible only at the base; the antennæ are scarcely longer than in the preceding, but their last joint is not constricted. It has the general appearance of Corymbites pyrrhos, but the thorax is less elongate, and the posterior angles less produced.

10. A. consentaneus, fusco-piceus, helvo-pubescens, thorace latitudine longiore, ante basin non latiore, lateribus ante medium late rotundatis, angulis posticis paulo productis, apice rotundatis, confertim punctato, postice subcanaliculato, elytris striis antice profundius punctatis, interstitiis paulo convexis, punctatis, pedibus antennisque ferrugineis, vel piceis, his articulo ultimo constricto. Long. ·65.

One specimen from New York, having reddish feet and antennæ, and another from Michigan with the same parts dark brown. This species seems different on account of the longer and more obtuse thoracic angles, which prevent it from being associated with either of the two preceding; the thoracic angles do not diverge at all, in which respect with differs from the next, but may, nevertheless, be the male of it. The thorax is as densely punctured as in A. melanopthalmus.

11. A. bilobatus, nigro-piceus, helvo-pubescens, thorace latitudine longiore, convexiusculo, medio parcius, lateribus sat dense punctato, lateribus vix late rotundatis, angulis posticis paulo productis, divergentibus apice rotundatis, elytris striis antice profunde punctatis, interstitiis paulo convexis punctatis, pedibus ferrugineis, antennis fuscis, articulo ultimo constricto. Long. ·60.

Elater bilobatus Say, Trans. Am. Phil. Soc. 6, 174.

One specimen, Wisconsin, Dr. Hoy. Say describes the antennæ as of the same colour as the legs, but we see from the preceding species that this is not a constant character. This one differs by its more convex and less densely punctured thorax, and the more divergent and more rounded angles; the sides of the thorax are very slightly rounded, and are a little sinuous near the posterior angles. From all the others, except the preceding, this is known by the more deeply punctured striæ of the elytra.

12. A. planatus, piceus, helvo-pubescens, thorace latitudine longiore, lateribus antice late rotundatis, confertim punctato, angulis posticis paulo productis, non divergentibus, apice rotundatis, elytris striis profundis, antice paulo punctatis, interstitiis omnino planis parce punctulatis, subtus rufo-piceus, pedibus pallidioribus, antennis articulo ultimo non constricto. Long. ·60.

One specimen, New Jersey, Mr. Guex. This species precisely resembles in form A. consentaneus, and only differs by the angles of the thorax being still more rounded, and the striæ of the elytra being less punctured, with entirely flat interstices; the last joint of the antennæ does not appear constricted.

13. A. cavifrons, rufo-testaceus, paulo pubescens, thorace latitudine longiore, lateribus parallelis, antice vix rotundatis, confertim punctato, angulis posticis modice productis, acutis, elytris striis punctatis, interstitiis paulo convexis parce subtiliter punctatis, antennis articulo ultimo constricto. Long. ·5.

Athous cavifrons Melsheimer, Proc. Acad. Nat. Sc. 2, 154.

Pennsylvania and Georgia. The thorax of the female is a little more convex than that of the male, and the sides converge a little in front. The clypeus is not more concave than in the other species of this division, from all of which it is easily distinguished by its smaller size and less densely pubescent body, as well as by its brighter colour.

Crigmus *Lec.*

Frons parum convexa, antice depressa, non marginata, margine laterali obliqua, ad apicem extensa: fossulæ antennales distantes, bene definitæ: labrum antice rotundatum, mandibulæ apice acutæ, edentatæ: antennæ valde serratæ, articulo 1mo mediocri subconico, 2 et 3 parvis, æqualibus, 4—10 æqualibus triangularibus, 11mo valde constricto, fere diviso: palpi articulo ultimo triangulari, acuto: prosternum antice lobatum, postice mucronatum, mucrone non inflexo, sutura oblique concava, antice non excavata: mesosternum non protuberans: coxæ posticæ intus fere sensim paulo dilatatæ, dente interno magno acuto: tarsi filiformes pubescentes, articulo 1mo sequentibus duobus coniunctis æquali, 2—4 sensim brevioribus, 5to præcedentibus 2 æquali, unguiculis integris.

I have formed this genus upon Aphanobius hepaticus Germ., which appears sufficiently distinct from the type of the genus, A. infuscatus, on account of the declivous mesosternum, and shorter first joint of the antennæ. The tooth at the internal part of the posterior coxæ is stronger and more acute, while the posterior margin of the plate is not undulated, as in A. infuscatus, but regularly and very slightly curved; the pubescence of the tarsi is uniform, without any tendency to form brushes as in A. infuscatus. The external resemblance (barring size) is very great, but we have frequent examples in this family of close external resemblance among species of most widely distinct genera. With regard to the weight of the character derived from the mesosternum, that will become evident, I think, to any one who will observe the constancy of the protuberant form, through a large group of species, which carry in their appearance the evidence of the distinctness of their type. Adopting such a principle of division, Aphanobius infuscatus will then form the osculant of the group with protuberant mesosternum with the present genus.

1. C. hepaticus, obscure castaneus, dense longius helvo-pubescens, thorace latitudine longiore confertim punctato, subcylindrico, lateribus antice paulo rotundatis, elytris fastigiatis, apice muticis, striis punctatis interstitiis confertim punctatis et rugosis, pedibus antennisque rufis. Long. ·6—·74.

Elater hepaticus Germar, Ins. Nov. 43.

Aphanobius hepaticus Germar, Zeitschr. 5, 184.

Georgia and Texas; South America, according to Germar. The posterior angles of the thorax are long, acute, and carinated; there are no basal fissures.

2. C. texanus, obscure castaneus, dense longius helvo-pubescens, thorace confertim punctato, antrorsum angustato, latitudine non longiore, lateribus rectis antice rotundatis, elytris fastigiatis, muticis, striis punctatis, interstitiis confertim punctatis et rugosis, pedibus rufescentibus. Long. ·7.

Two specimens collected by Mr. Schott, of the Mexican Boundary Commission, at Eagle Pass, on the lower Rio Grande. Only differs from the preceding by the thorax being shorter and distinctly narrowed anteriorly.

Atractopterus *Lec.*

Frons modice convexa, lateribus oblique marginatis, margine fere ad apicem extendente, fossulis antennarum bene definitis distantibus: labrum subemarginatum: mandibulæ versus apicem dentatæ, apice acutæ: antennæ serratæ, articulo 1mo breviusculo, 2 et 3 subcylindricis, illo breviore, 4—10 triangularibus, 11mo apice subacuminato: palpi articulo ultimo parum dilatato apice rotundato: prosternum antice breviter lobatum, mucrone postico vix inflexo, sutura laterali non excavata, oblique concava: mesosternum non protuberans: coxæ posticæ laminis angustis, intus parum dilatatis, dente interno minusculo acuto: tarsi æqualiter pubescentes, filiformes, articulo 1mo vix longiore, 2—4 sensim paulo brevioribus, 5to præcedentibus 3 æquali unguiculis maiusculis integris.

Differs from Crigmus by its convex front, and less elongate first tarsal joint; from Ludius by the narrower, less dilated, and less dentate coxal laminæ. The form of body is narrow and fusiform, being narrowed each way from the base of the elytra, which are acute at the tip; the posterior angles of the thorax are acute, and carinated; there are no basal fissures.

1. A. fusiformis, nigro-viridis, cinereo-pubescens, thorace punctato, latitudine longiore, antrorsum angustato, lateribus rectis, angulis posticis elongatis, sæpe testaceis, elytris piceo-testaceis, striatis, interstitiis paulo convexis sat dense punctatis, apice subacutis, pedibus testaceis, antennarum articulo 1mo rufo. Long. ·55.

Lake Superior, not rare. It is the *Pristilophus fusiformis* of my catalogue in Agassiz' Lake Superior.

2. A. viridanus, ferrugineus, supra piceo-æneus, tenuiter cinereo-pubescens, thorace latitudine longiore, subcylindrico, lateribus rectis, ad apicem rotundatis, parce punctato, margine omni ferrugineo, pone medium canaliculato, ante medium utrinque fovea profunda impresso, elytris striis punctatis vix impressis, interstitiis planis, parce punctulatis, antennis nigris basi rufis. Long. ·35.

Elater viridanus Say, Ann. Lyc. 1, 250.

Elater subluccns Randall, Bost. Journ. Nat. Hist. 2, 37.

Pennsylvania, Dr. Melsheimer. A small species, looking like a Dolopius, and very remarkable by the two deep foveæ before the middle of the thorax; the form is less cuneate than that of the preceding species; the thorax is almost parallel on the sides, and the elytra slightly rounded in their outline. The vertex is marked with a longitudinal fovea, as in Dolopius, from which, however, it differs essentially by its less convex front, and shorter basal joint of the antenna.

3. A. incongruus, tenuiter cinereo-pubescens, capite thoraceque olivaceis, opacis, confertim punctatis, thorace latitudine longiore, lateribus postice parallelis ante medium late rotundatis, sæpe

rufo-bivittato, elytris testaceis, striis tenuibus vix punctulatis, interstitiis planis, dense scabro-punctatis, abdomine, prosterni lobo, thoracis parte inflexa, antennarum articulo 1mo, pedibusque testaceis Long. ·28—·37.

Lake Superior: one specimen with the thorax blackish green, and two with a broad discoidal reddish yellow vitta each side. This species is less slender than A. viridanus, and the thorax is more broadly rounded anteriorly, so that it appears less cylindrical. The postpectus is black.

A specimen found with those just mentioned has the thorax entirely greenish black, above and beneath, with the sides much more straight, converging slightly and rounded only near the apex; the disc is punctured as in this species, but has two anterior foveæ as in A. viridanus; the abdomen, like the pectus, is black, and does not show any reddish tinge. This may be a distinct species, but until the sexual differences are better understood, I think it better to permit it to remain under A. incongruus.

Ludius *Latr.*

1. L. abruptus, niger, dense punctatus, fusco-subsericeus, tarsis piceis; elytris postice obsolete striatis, ad apicem non acuminatis. Long. ·8.

Elater abruptus Say, Ann. Lyc. 1, 253; Trans. Phil. Soc. 6, 166.
Ludius coracinus Germ. Zeitschr. 4, 47.

Middle, Southern, and Western States; rare.

2. L. attenuatus, obscure picco-sanguineus, dense punctatus, fusco-subsericeus, elytris versus apicem, antennis, pedibusque nigris, elytris postice vix obsolete striatis apice acuminatis. Long. ·9.

Elater attenuatus Say, Ann. Lyc. 1, 257; Trans. Am. Phil. Soc. 6, 166.

Middle, Southern, and Western States; more abundant than the preceding.

Dolopius *Esch.*

Latreille and Germar have already asserted that the genera Dolopius, Agriotes, and Ectinus, of Eschscholtz, were separated on evanescent characters; and after patiently examining our native species I have adopted their opinion. Differences of organic character, although too slight for generic distinction, are readily found, and enable us to facilitate the determination of the species, which may be grouped as follows:

A. Mandibulæ perpendiculariter dilatatæ, apice emarginatæ - - - Sp. 1.
B. Mandibulæ apice compressæ, non dilatatæ:
1. Antennæ articulis 2 et 3, 4to coniunctis æqualibus - - - Sp. 2—3.
2. Antennæ articulis 2 et 3, 4to singulis vix brevioribus.
* Laminæ coxarum intus vix latiores, (thoracis margine plus minus obsoleto:) - - - - - - - - - Sp. 4—9.
** Laminæ coxarum intus subito paulo dilatatæ, (thoracis margine integro:) - - - - - - - - - Sp. 10—13.

A.

1. D. mancus, crassiusculus, ater, vel piceus, pubescens, capite thoraceque confertim sat gros-

punctatis, hoc latitudine vix breviore, lateribus parallelis antice rotundatis, angulis posticis subdivergentibus, elytris striis profundis punctatis, interstitiis planiusculis, rugose punctatis, antennis pedibusque rufis. Long ·3—·35.

Elater mancus Say, Journ. Acad. Nat. Sc. 3, 171; Trans. Am. Phil. Soc. 6, 168.

? Elater obesus Say, Journ. Acad. Nat. Sc. 3, 168; Trans. Am. Phil. Soc. 6, 168.

Elater (*Agriotes*) *obesus* ‡ Harris, Ins. Massachusetts, Injurious to Vegetation, 2d ed. p. 49.

Agriotes truncatus Melsheimer, Proc. Acad. Nat. Sc. 2, 217.

Agriotes striatulus Melsheimer, Proc. Acad. Nat. Sc. 2, 217.

Lake Superior and throughout the Atlantic portion of the United States. A specimen was communicated to me by Dr. Harris as *Elater obesus* Say: the remarks under that species in the Transactions of this Society are as follows: "The clypeus is not prominent and the thoracic spines are not carinated; the elytra in one specimen are acuminated at the tip: the nails are very robust on the basal half, which terminates at the middle in a prominent tooth, separated by a deep fissure." Now in the present species, as in all others arranged under this genus, the spines of the thorax are strongly carinated, and the ungues are not toothed. For these reasons I cannot adopt Dr. Harris' view regarding this species, which appears to me to agree more nearly with Say's El. mancus. The basal fissure of the thorax is more distinct than in the other species, in all of which it is almost wanting.

B.—1.

2. D. oblongicollis, valde elongatus, fusco-niger, pubescens, thorace latitudine plus sesqui longiore, lateribus parallelis, antice paulo rotundatis, confertim punctato, elytris striis punctatis, interstitiis sat dense punctatis, antennis piceis, articulis 2 et 3 coniunctis 4to fere brevioribus, pedibus testaceis. Long. ·31—·35.

Melsheimer, Proc. Acad. Nat. Sc. 2, 218.

Middle States, not rare. The anterior margin of the thorax is sometimes testaceous.

3. D. isabellinus, valde elongatus, luteo-testaceus, pubescens, capite antennisque fuscis, thorace latitudine sesqui longiore, lateribus parallelis, antice paulo rotundatis, minus subtiliter punctato, elytris striis punctatis, interstitiis sat dense punctatis, antennis articulis 2 et 3 coniunctis 4to fere brevioribus. Long. ·37.

Melsheimer, Proc. Acad. Nat. Sc. 2, 218.

Pennsylvania. I have seen only the typical specimen in Dr. Melsheimer's collection. It differs from the preceding only by the coarser and less dense punctuation of the thorax.

B.—2*.

4. D. collaris, niger, pubescens, thorace latitudine longiore, postice subcanaliculato, lateribus parallelis, antice rotundatis, confertim minus subtiliter punctato, lateribus late rufis, angulis posticis elongatis, elytris testaceis, striis subtilius punctatis, interstitiis minus dense punctulatis, antennis pedibusque rufo-testaceis. Long. ·49.

Two specimens, Vermont, Prof. C. B. Adams. Size and form of the next species, and, apart from colour, only distinguished from it by the less densely punctulate elytra.

5. D. fucosus, ater, opacus, pubescens, thorace latitudine longiore postice subcanaliculato, lateribus parallelis, antice rotundatis, confertim minus subtiliter punctato, lateribus sæpissime late ob-

scure sanguineis, elytris striis subtilius punctatis, interstitiis confertim rugose punctulatis. Long. ·43—·55.

Lake Superior and Vermont. The antennæ and legs are black, with a faint pitchy lustre: the sanguineous colour of the sides of the thorax is sometimes almost wanting; at other times it is quite bright, and extends upon the inflexed portion, and even to the anterior margin of the prosternum.

6. D. pubescens, ater, subnitidus, pubescens, thorace latitudine vix longiore, postice canaliculato, lateribus postice parallelis antice rotundatis, sat dense punctato, elytris striis subtiliter punctatis, interstitiis confertim rugose punctulatis, antennarum basi pedibusque fusco-testaceis. Long. ·36.

Agriotes pubescens Melsheimer, Proc. Acad. Nat. Sc. 2, 217.

Pennsylvania and Lake Superior. Smaller and more robust than the preceding, and with the punctures of the thorax less dense: differs from D. avulsus by its larger size, shorter and more densely punctured thorax, and by its much less lustrous surface. The antennæ in one specimen are fuscous, in the other black, with the basal joints testaceous.

7. D. avulsus, niger, nitidus, minus dense helvo-pubescens, thorace latitudine longiore postice canaliculato, lateribus paulo obliquis, antice rotundatis, parcius grossius punctato, angulis posticis subdivergentibus, elytris striis punctatis, interstitiis vage punctulatis et rugosis, antennis pedibusque rufis. Long. ·3.

Pennsylvania and Vermont. Differs from the preceding by its more brilliant colour, brownish and less dense pubescence, and by the coarser and more distant punctures of the thorax.

8. D. sordidus, fuscus, dense cinereo-pubescens, thorace latitudine non longiore, lateribus parallelis antice rotundatis, postice canaliculato, confertim punctato, angulis posticis non divergentibus, elytris striis punctatis, interstitiis confertim rugose punctulatis, antennis rufis pedibus flavis. Long. ·3.

New York, Mr. Guex: a specimen also in Dr. Harris' collection. Resembles somewhat D. mancus, but is less robust; the mandibles, although obtuse, are not dilated and emarginate, as in that species: it is sufficiently distinct from all the other species of this division by its densely and more finely punctured thorax, and more dense pubescence.

9. D. stabilis, ater, fere opacus, pubescens, thorace latitudine longiore, lateribus subparallelis, antice rotundatis, alutaceo, ante medium confertim subtilius punctato, angulis posticis vix divergentibus, elytris sæpe picco-testaceis, striis acutis punctatis, interstitiis planis confertissime rugose punctulatis, antennis pedibusque picco-testaceis. Long. ·33—·45.

Lake Superior, abundant. A species easily recognised, and very remarkable for the sculpture of the thorax, the surface of which is finely chagrined, with distinct punctures only in front of the middle: the head is densely punctured. By a very powerful lens, the chagrining of the thorax is seen to be produced by an infinity of very small punctures.

B.—2**.

10. D. limosus, ater, flavo-pubescens, clypeo truncato, thorace latitudine longiore, lateribus parallelis, ad apicem rotundatis, postice canaliculato, confertim punctato, angulis posticis rufescentibus non divaricatis, elytris testaceis, striis acutis punctatis, interstitiis confertim rugose punctulatis, antennis pedibusque rufo-testaceis. Long. ·35.

Lake Superior, not rare. This species connects this with the last division of the genus: the second and third joints of the antennæ are hardly smaller than the fourth, and the laminæ of the posterior coxæ are distinctly wider internally: the tooth is, however, not so prominent as in the following species, and the clypeus is decidedly truncate at the tip, and considerably elevated above the labrum: the lateral margin of the thorax is well marked for its whole length, and is not deflexed so as to belong to the under surface, as in the preceding species.

11. D. p a u p e r, ater, pubescens, clypeo truncato, thorace latitudine vix longiore, lateribus parallelis, ad apicem rotundatis, apice et angulis posticis testaceis, confertim punctato, postice canaliculato, elytris striis acutis punctulatis, interstitiis planis confertim rugose punctulatis, vitta rufo-picea a humero ad apicem plus minusve distincta, antennis fuscis, basi pedibusque rufo-testaceis. Long. ·22—·29.

Abundant throughout the Atlantic parts of North America. A specimen was sent me by Dr. Harris as *Elater inquinatus* Say, which, however, being said (Trans. Am. Phil. Soc. 6, 175) to have the fourth tarsal joint lobed, and the thorax with an elongate basal fissure each side, cannot belong to this genus. From the manner in which Say distributed types of his species in Europe, I fear that he was not very careful in naming his duplicates, probably trusting to his usually excellent descriptions, for the identification of those described by him. I am inclined to believe that E. inquinatus *Say* must be referred to Adrastus, and that the serration of the ungues was probably overlooked.

Two specimens from Lake Superior are much larger, (·34 unc.) and have the striæ of the elytra less distinctly marked. They do not seem, however, to constitute a separate species.

12. D. s u b u s t u s, fusco-niger, pubescens, thorace rufo-testaceo, marginibus dilutioribus, dense punctato, latitudine vix longiore, lateribus parallelis antice vix rotundatis, elytris rufo-testaceis, basi, sutura margineque leviter infuscatis, striis punctatis interstitiis planis, confertim rugose punctatis, antennis nigro-piceis, pedibus rufis. Long. ·27.

Two specimens found at San Francisco, California. Somewhat more slender than D. pauper, which, except in colour, it very much resembles: the lateral oblique lines of the front are indistinctly connected anteriorly, and the vertex is not marked with the usual oblong fovea.

13. D. b i g e m i n a t u s, subcylindricus, ater, pubescens, thorace latitudine fere sesqui longiore lateribus parallelis, antice vix rotundatis, confertim punctato, elytris macula utrinque elongata pone basin, alteraque pone medium rotundata, læte rufo-testaceis, striis punctatis, interstitiis sat dense rugose punctatis, pedibus testaceis, antennis vel fuscis vel testaceis. Long. ·21.

Elater bigeminatus Randall, Bost. Journ. Nat. Hist. 2, 37.

Lake Superior, Massachusetts and Pennsylvania, rare. This species has the commissure of the oblique frontal lines quite distinct, as in Adrastus, but the ungues are absolutely without teeth: the vertex, as in the preceding species, is not foveate.

Adrastus *Esch.*

The species below mentioned have the third and fourth joints of the tarsi slightly lobed

beneath, and all belong to Erichson's first division. Their appearance is altogether that of Dolopius, except that the elytra are slightly cuneate, and the front is distinctly angulated: the angles of the thorax are not carinated, and the basal fissures are long.

1. A. r e c t i c o l l i s, piceus, pubescens, thorace lateribus dilutioribus, antice paulo rotundatis, minus dense punctato, angulis posticis subdivergentibus, elytris testaceis sutura infuscata, striis profundis punctatis, interstitiis parce punctatis, antennis pedibusque rufo-testaceis. Long. ·2.

Elater recticollis Say, Journ. Acad. Nat. Sc. 3, 168: (*inscius*) Trans. Am. Phil. Soc. 6, 184.

Adrastus pumilus Erichson, Germ. Zeitschr. 3, 120.

Middle States, not common. The difference between this and the following, except in colour, is not obvious: the sides of the thorax, however, appear to be less suddenly rounded in front, and the disc is more convex: the posterior angles appear more elongated and divergent.

2. A. t e s t a c e u s, rufo-testaceus, pubescens, thorace minus dense punctato, lateribus rectis, antice breviter paulo rotundatis, angulis posticis non divergentibus, elytris striis profundis punctatis, interstitiis parce punctatis. Long. ·18.

Melsheimer, Proc. Acad. Nat. Sc. 2, 219.

Pennsylvania and Georgia. The sides of the thorax are entirely straight, except immediately at the apex, where they are rounded.

Two specimens from the Southern States agree in form with this species, but are of a fuscous colour, with the antennæ and feet testaceous; they can scarcely be separated.

To this genus must belong Elater q u i e t u s *Say*, (Trans. Am. Phil. Soc. 6, 181:) a black species with yellow antennæ and feet, and having the apex of the clypeus more obtuse than in A. recticollis. It is ·2 unc. long, and was found in Indiana.

Here, probably, must be placed Elater i n q u i n a t u s *Say*, (ibid. 175:) but the serration of the ungues is not mentioned: vide remarks under Dolopius pauper.

Anchastus *Lec.*

Frons convexa, antice subangulatim marginata: mandibulæ breves, basi triangulariter extus dilatatæ (sicut in Dolopio:) labrum antice rotundatum: antennæ articulo 1mo mediocri, parum serratæ, articulis 2 et 3, 4to coniunctis non longioribus: prosternum lobatum, mucrone postico subinflexo, sutura laterali concava, antice excavata: mesosternum non protuberans: coxæ posticæ laminis intus valde dilatatis, margine autem postico non emarginato, dente forti interno instructo: tarsi pubescentes, articulo 1mo elongato, sequentibus duobus longiore: 3to subtus longe lobato, 4to parvo, 5to tenui unguiculis integris.

From Dicrepidius this genus differs by the second joint of the tarsi being simple; from Dicrepidius, Elater, and in fact from all the genera of true Elaterida, described in this essay, it differs by the very great dilatation of the coxal plates internally; their posterior margin is somewhat oblique, though not sinuate as in Dicrepidius and Elater. The posterior angles of the thorax are acute, strongly carinate, and not diverging; there are no basal fissures. This genus seems related to Physorhinus.

1. A. d i g i t a t u s, fusco-piceus, elongatus, helvo-pubescens, thorace latitudine longiore, antrorsum angustato, lateribus rectis ante medium rotundatis, angulis posticis elongatis, dense punctato,

elytris a basi subangustatis, striis punctulatis, interstitiis confertim rugose punctulatis, antennis articulis 2 et 3 subcylindricis, 4to coniunctis non longioribus. Long. ·43.

One specimen, Pennsylvania. The narrow arched body, narrowed at each end, with the thorax fitted closely to the elytra, give this species very much the appearance of some of the Eucnemides; the front is more convex than in the other species, and is almost angulated at the tip. The lobe of the third tarsal joint is very long, extending to the middle of the last joint; the outer margin of the plates of the posterior coxæ is oblique, and the posterior margin also a little oblique inwards, and they unite in an obtuse angle not prominent, but scarcely rounded. The thorax has a short furrow at the middle of the disc, which is possibly accidental; the carinæ of the posterior angles diverge very much from the margin.

2. A. recedens, latiusculus, fusco-niger, sordide pubescens, thorace latitudine fere breviore, antrorsum angustato, lateribus rotundatis, subtilius punctato (punctulis paucis intermixtis,) angulis posticis modice productis acutis, elytris parallelis postice rotundatis, striis punctatis, interstitiis planis rugose punctulatis, antennis articulis 2 et 3 subcylindricis, 4to coniunctis vix longioribus. Long. ·2—·24.

San Francisco. The smaller sized individuals appear to be more densely pubescent, and the punctures of the thorax appear more distinct;—they do not, however, seem to be specifically distinct. The sides of the thorax are more rounded anteriorly than at the base, but are not straight at any part; the carina diverges very much from the margin, as in the preceding, and the front is moderately convex and slightly angulated. The lobe of the third joint of the tarsi does not reach quite to the middle of the fifth joint.

To this genus may possibly be referred Cryptohypnus cinereipennis *Man.* (Monocrepidius cinereipennis *Esch.*) and C. puberulus *Man.* (Bull. Mosc. 1843, p. 240;) of which the fourth tarsal joint is said to be lobed. The difficulty of determining whether the lobe proceeds from the third or fourth joint is sometimes very great. At all events the species alluded to cannot be retained in Cryptohypnus, and a new examination is necessary to fix their true affinity.

Brachycrepis *Lec.*

Frons convexa, antice vix producta, rotundatim marginata, non impressa: labrum antice rotundatum: antennæ valde serratæ, articulo 1mo mediocri, 2do parvo, 3^io^ sequenti æquali, 11mo præcedenti non longiore, simplici: prosternum antice lobatum, mucrone postico subinflexo, sutura laterali paulo concava, antice excavata: mesosternum non protuberans, coxæ posticæ laminis intus subito quadrangulariter valde dilatatis, margine postico subsinuato, dente interno mediocri, acuto: tarsi pubescentes articulo 1mo sequentibus coniunctis æquali: 2^ndo^ plus duplo breviore, subtus vix lobato, 3^io^ brevi, subtus breviter lobato, 4to parvo recepto, 5to 2^ndo^ æquali, unguiculis integris.

The lobe of the third joint of the tarsi does not extend beyond the fourth joint. This genus differs from Dicrepidius by the more sudden dilatation of the coxal plates, as well as by the structure of the tarsi; from Anchastus, it is readily known by the distinctness of the outer angle of the coxal plate (the posterior margin of which is not oblique inwards, but slightly emarginate,) and by the structure of the antennæ and tarsi. The posterior angles of the thorax have two acute carinæ, one parallel with the margin as in Dicrepidius, the other diverging as in Anchastus.

1. B. bicarinatus, elongatus, fusco-castaneus, helvo-pubescens, thoracе latitudine longiore, antrorsum angustato, lateribus late rotundatis, subtilius punctato, angulis posticis acutis, bicarinatis, elytris striis punctatis, interstitiis rugose punctatis, abdomine rufescente, pedibus antennisque rufo-testaceis. Long. ·31.

One specimen, Georgia. The striæ of the elytra are well impressed; it resembles in appearance a small specimen of Dicrepidius soleatus, but is at once known by its finely punctured thorax.

DICREPIDIUS *Esch.* (*emend.*)

Frons modice convexa, antice producta, et rotundatim marginata, sæpe ad apicem bicristata: mandibulæ emarginatæ, basi triangulariter subdilatatæ: labrum antice rotundatum: antennæ plus minus serratæ, maris nonnunquam ramosi, articulo 3^io^ 4to æquali, 11mo non constricto: prosternum antice breviter lobatum, mucrone postico paulo inflexo, sutura laterali antice excavata, paulo concava: mesosternum non protuberans: coxæ posticæ laminis intus subsubito modice dilatatis, postice emarginatis, dente interno forti, acuto: tarsi pubescentes, articulo 1mo sequentibus 2 æquali, 2 et 3 subtus lobatis, 4to parvo recepto, 5to unguiculis integris, maiusculis.

I have modified the diagnosis of this genus, as given by Germar, to allow the introduction of several species, which seem to differ from the type only in the absence of the two acute perpendicular ridges which run from the margin of the front to the base of the labrum, and limit the foveæ in which the antennæ are inserted. From the two preceding genera, this differs in the form of the laminæ of the posterior coxæ, which are emarginate, or sinuate posteriorly, as in Elater. The posterior angles of the thorax are long and sharp, the carina is well defined and almost parallel with the margin; the basal fissures are short and distinct.

A. *Frons antice bicristata.*

1. D. ramicornis, picco-rufus, helvo-pubescens, thoracе minus subtiliter parce punctato, latitudine longiore, lateribus parallelis, antice paulo rotundatis, linea dorsali lævi vix distincta, elytris postice angustatis, striis minus impressis antice fortiter punctatis, interstitiis parce subtiliter punctulatis. Long. ·55.

Germar, Zeitschr. 1, 211.

Elater ramicornis Beauv. Ins. p. 10, tab. 7, fig. 3; ibid. 214, tab. 9, fig. 7.

Southern States, rare; more abundant in Cuba and South America. In the male the third and following joints of the antennæ are furnished with a subapical, elongate, spatulate process; the eleventh joint extends beyond the branch of the tenth joint; in the female the joints are triangular, growing gradually narrower, with the last joint one-half longer than the tenth.

2. D.? binus, niger, helvo-pubescens, thoracе latitudine longiore, antrorsum subangustato, lateribus fere rectis, antice paulo rotundatis, subtilius punctato, densius ad latera, angulis posticis acutis, carina angulari valde elongata, margini parallela, elytris striis profundis punctulatis, interstitiis confertim rugose punctatis, macula magna utrinque basali, alteraque versus apicem læte rufo testaceis, antennis pedibusque testaceis. Long. ·29.

Elater binus Say, Trans. Am. Phil. Soc. 6, 178.

One specimen, Georgia. As the tarsi and posterior coxæ of my specimen are in bad condition, I am not absolutely certain that it belongs to this genus; the two crests of the

anterior portion of the front are distinct, but more distant than in the preceding species; the antennæ are only slightly serrate, and the third joint is not as wide as the fourth; the carina of the posterior angles of the thorax reaches almost to the middle; the first joint, especially of the anterior tarsi, is longer in proportion than in the preceding species; the second joint appears to be lobed, but I am not certain that it is so; the third joint is nearly as long as the second, and extends beneath into a lobe, beyond the fourth joint, which is very small; the fifth is as long as the three preceding, with small slender nails.

Say describes the tarsi as having the penultimate joint lobed, but as the present species agrees in every other respect with his description, I think we may be justified in considering his observation as an error.

B. *Frons non cristata.*

3. D. ferreus, rufo-piceus, longius helvo-pilosus, fronte concava, thorace parce grossius punctato, latitudine vix longiore, antrorsum angustato, et lateribus paulo rotundato, spatio dorsali indistincto lævi, elytris postice angustatis, striis punctatis, interstitiis subconvexis parce punctatis. Long. ·56.

One specimen, Texas, Lieut. Haldeman. The front is more produced than in D. ramicornis, and is slightly concave above; the posterior angles of the thorax are carinated, but the carina is less acute than in that species. The lobes of the tarsi extend to the middle of the last joint. The antennæ are blackish and formed exactly as in the female of D. ramicornis, but are a little broader. The punctures of the thorax are distant in the middle, but moderately close on the sides; there is a rounded indistinct smooth dorsal space behind the middle.

4. D. soleatus, supra castaneus, helvo-pilosus, fronte subconcava, thorace grossius, lateribus densius punctato, latitudine longiore, antrorsum angustato, lateribus rectis, antice paulo rotundatis, elytris subparallelis, postice rotundatis, striis punctatis, interstitiis parce punctatis, postpectore, abdomine, antennis pedibusque rufis. Long. ·45.

Elater soleatus Say, Trans. Am. Phil. Soc. 6, 176.

One specimen, Michigan. This species is closely related to the preceding, but the more densely punctured thorax, and rufous antennæ, distinguish it at once; the thorax is more narrowed anteriorly, and less rounded on the sides; the posterior angles are more acutely carinated.

Say states that the second joint of the antennæ is "not more than half the length of the third;" in my specimen, as in the preceding and next species, it is only about one-third as long as the third joint.

5. D. simplex, piceus, helvo-pilosus, fronte vix concava, thorace minus dense punctato, postice canaliculato, antrorsum angustato, lateribus parum rotundatis, elytris striis fortius punctatis, interstitiis planis parce punctulatis, antennis rufo-piceis, pedibus testaceis. Long. ·35.

One specimen, Texas, Lieut. Haldeman. From D. ferreus it is distinguished by its smaller size, brown antennæ, unimpressed front, and testaceous feet; from D. soleatus by the less densely punctured thorax, the less deep and more strongly punctured striæ of the elytra, and by the deeper colour of the under surface. The carina of the posterior angles of the thorax is as acute as in D. soleatus.

ELATER *Linn.* (*Esch. emend.*)

Ampedus *Germ.*

A.

Densely punctured, opaque species, having the first joint of the antennæ short, the second and third small and equal, the following large and triangular, and the eleventh more or less distinctly constricted: the front is convex, the margin distinct, forming anteriorly an angle, the apex of which is rounded. The lateral suture of the prosternum is not excavated anteriorly. The mandibles are acute at tip, with an obtuse tooth beyond the middle.

1. E. Sturmii, ater, opacus, brevissime pubescens, thorace convexo, lateribus parallelis antice rotundatis confertissime punctato, postice canaliculato, elytris parallelis versus apicem angustatis, striis profundis punctatis, interstitiis subtiliter dense scabro-punctatis, antennarum articulo ultimo distincte constricto. Long. ·47—·6.

Aphanobius Sturmii Germ. Zeitschr. 5, 188.

Ectinus granulosus Melsheimer, Proc. Acad. Nat. Sc. 2, 159.

Middle and Southern States, rare.

2. E. turbulentus, ater opacus, breviter hispide pubescens, thorace subconvexo, antrorsum subangustato, et lateribus late rotundatis, confertissime punctato, postice canaliculato, elytris gradatim angustatis turbido-luteis, pone medium confuse nigro-nebulosis, macula utrinque transversa pallidiore, striis profundis punctatis, infuscatis, interstitiis subtiliter dense scabro-punctatis, antennarum articulo 11mo modice constricto. Long. ·58.

Two specimens found near San Diego, on a kind of grass, in June. Similar in all its characters to the preceding, but with the sides of the elytra less parallel, and the posterior angles of the thorax more diverging: the elytra are dirty yellow, with the striæ brownish: behind the middle is a large, indistinct, blackish cloud, which includes on each elytron a transverse slightly reniform yellow spot, paler than the ground colour of the elytra. In one specimen the cloudiness is seen only on the margins of this spot, which is also very indistinct.

3. E. limbalis, opacus, niger, breviter hispide flavo-pubescens, thorace punctatissimo elongato, antrorsum angustato, lateribus rectis, luteo, macula media margineque basali nigris, elytris striis profundis punctatis, interstitiis confertissime subtilius scabro-punctatis, sutura margineque luteis, antennis basi rufo-piceis, articulo 11mo paulo constricto. Long. ·31—·45.

Herbst, Käfer, 10, 53; tab. 162, fig. 10: Say, Trans. Am. Phil. Soc. 6, 167.

Ampedus limbalis Germ. Zeitschr. 5, 164.

Middle, Southern, and Western States, not rare. Varies with the yellow sutural margin becoming obsolete about the middle: the thoracic spot varies in size, sometimes reaching both the tip and base of the thorax.

B.

Moderate-sized, or small species, mostly cuneate in form, with the thorax only slightly convex, and considerably narrowed in front: the anterior margin of the front which is

convex) always distinct and angulated: the first joint of the antennæ short, the second small, the third longer and wider than the second, usually much narrower than the fourth, but varying in this respect both in species and sex: the joints 4—10 triangular, decreasing slightly in breadth, eleventh oval, not constricted. Prosternum with the lateral suture anteriorly excavated for the reception of the antennæ.

4. E. rubricollis, ater opacus, helvo-pubescens, capite thoraceque confertissime fere scabro-punctatis, obscure sanguineis, elytris striis profundis punctatis, interstitiis convexis confertim punctatis, antennarum articulo 3^io^ præcedente duplo longiore, subtriangulari. Long. ·5—·58.

Herbst, Käfer, 10, 49, tab. 162, fig. 6, (1801;) Say, Journ. Acad. Nat. Sc. 3, 177; Harris, Trans. Hartford Soc. Nat. Hist. 71.

Elater verticinus Beauvois, Ins. 214, tab. 9, fig. 6, (1805;) Say, Ann. Lyc. 1, 268.

Ampedus rubricollis Germ. Zeitschr. 5, 171.

Middle, Southern, and Western States; not rare in Georgia. The last joint of the antennæ is slightly sinuate or constricted beyond the middle.

5. E. nigricollis, ater cinereo-pubescens, thorace confertim punctato, versus latera fere scabro, elytris pallidis subcuneatis, striis profundis punctatis, interstitiis subconvexis punctulatis, pedibus testaceis, antennarum articulo 3^io^ præcedente duplo maiore triangulari. Long. ·33—·42.

Herbst, Käfer, 10, 73, tab. 164, fig. 7; Say, Journ. Acad. Nat. Sc. 3, 176.

Ampedus nigricollis Germ. Zeitschr. 5, 166.

Middle and Southern States, not rare. The base of the antennæ is indistinctly testaceous: the third joint is considerably dilated, though not as large or as broad as the fourth: the last joint of the antennæ is not at all constricted.

6. E. linteus, ater cinereo-pubescens, capite confertissime, thorace confertim punctato, versus latera fere scabro, elytris cuneatis pallidis, puncto humerali, sutura, apiceque nigris, striis profundis punctatis, interstitiis subconvexis parce punctatis, antennarum maris articulo 3^io^ sequenti fere æquali. Long. ·35—·42.

Say, Trans. Am. Phil. Soc. 6, 168.

Ampedus lugubris Germ. Zeitschr. 5, 165.

Middle and Southern States, and Lake Superior. The outer margin of the elytra is black. This species is subject to some variation: a specimen from Vermont has the legs testaceous, and the head less densely punctured than usual: in other specimens the head is almost scabrous: the female has the antennæ shorter, and the third joint much less dilated than the others. Germar does not cite Say's description; and although the species has long been known under the name proposed by Beauvois, I cannot find any description in his writings.

7. E. discoideus, ater, griseo-pubescens, capite thoraceque opacis, confertim punctatis, versus latera fere scabris, elytris cuneatis, basi margineque flavo-fulvis, striis profundis punctatis, interstitiis subconvexis rugose punctatis, antennarum maris articulo 3^io^ sequenti subæquali. Long. ·42—·38.

Fabr. Syst. El. 2, 240; Herbst, Käfer, 10, 132.

Ampedus discoideus Germ. Zeitschr. 5, 165.

Southern States, not rare. The female has the third joint of the antennæ very slightly dilated, and about twice the length of the second.

8. E. semicinctus, ater, subnitidus, griseo-pubescens, thorace sat dense, lateribus densius punctato, elytris cuneatis, basi fulvo-marginatis, striis profundis punctatis, interstitiis parce punctatis, antennis feminæ articulo 3to præcedente duplo longiore, vix dilatato. Long. ·45.

Randall, Bost. Journ. Nat. Hist. 2, 10.

One specimen, New York; found in Maine according to Mr. Randall. This species is closely allied to E. discoideus, which it resembles in form; the thorax is longer, less suddenly narrowed anteriorly, and not wider than the elytra; the elytra are margined with orange only at the base, and the punctures of the interstices are more regular; in the male, the third joint of the antennæ is probably dilated, as in E. discoideus.

9. E. læsus, ater opacus, griseo-pubescens, thorace confertim punctato, lateribus fere scabro, elytris basi late, lateribus antice, epipleurisque sanguineis, striis profundis punctatis, interstitiis subconvexis confertim rugose punctatis, antennis articulo 3to præcedente sesqui longiore (femineæ) vix latiore. Long. ·5.

One specimen, Georgia. Body black, with but little lustre, covered with fine grayish pubescence. Head densely punctured: antennæ not longer than the thorax, third joint one-half longer than the second, very slightly triangular; fourth and following broad, triangular; eleventh oval, not constricted. Thorax scarcely longer than wide, strongly narrowed and rounded in front, sides posteriorly subparallel, posterior angles scarcely diverging, carinate as in the other species; disc very densely punctured, anteriorly moderately convex, punctures becoming confluent at the sides: scutel black; elytra almost parallel anteriorly, narrowed and rounded posteriorly, base broadly sanguineous, the colour extending a little posteriorly on the sides; epipleuræ sanguineous; suture dusky; striæ deep, coarsely punctured, interstices convex, tolerably densely finely punctured and rugous. Beneath entirely black.

10. E. Sayi, ater, fere opacus, griseo-pubescens, thorace confertim punctato, lateribus fere scabro, elytris pallidis, sutura late, margine externo fere ad basin anguste nigris, striis profundis punctatis interstitiis subconvexis, disperse rugose punctulatis, antennarum articulo 3to subtriangulari, sequenti longitudine æquali. Long. ·5.

Elater oblessus (discoideus‖ *Fabr.*‡) Say, Trans. Am. Phil. Soc. 6, 165.

Middle States, rare. The broad black stripe along the suture gradually narrows near the scutellum: the exterior black margin reaches from the apex to the posterior part of the epipleuræ, where it ceases: the third joint of the antennæ is considerably narrower than the fourth, in both sexes; the eleventh joint is slightly constricted.

I have changed the name proposed by Say, not for its uncouthness, but because it does not properly belong to this species, and was intended as a substitute for a name given by Fabricius, which was supposed to be preoccupied: the reference, therefore, of the present species to that described by Fabricius, being, as already observed by Dr. Harris, an error, the name intended as a substitute fails, at least for this species. As the description, however, shows that this insect was known to Say, I have taken occasion to commemorate it with his name.

11. E. vitiosus, ater, subopacus, helvo-pubescens, thorace confertissime punctato, lateribus fere scabro, elytris sordide pallidis nimbo apicali atro, striis profundis punctatis, interstitiis disperse punctatis, antennarum articulo 3to (maris) triangulari sequente multo minore. Long. ·45

One specimen, Vermont, Prof. Adams. Body black, with very little lustre, covered with brownish hair. Head very densely punctured; antennæ with the third joint triangular, about twice as long as the second, but not more than half the size of the fourth: last joint not constricted. Thorax not longer than wide, narrowed gradually from the base, and broadly rounded on the sides, moderately convex, very densely punctured, punctures becoming confluent towards the sides: posterior angles less elongate than usual, elytra slightly narrowed from the very base, more strongly narrowed posteriorly, pale dirty yellow, with a large apical black blotch, the anterior limits of which are badly defined, and which extends farther along the side than on the suture: striæ deep, strongly punctured, interstices convex, moderately and finely punctured.

This species differs from the following not only by the apical blotch of the elytra extending to the apex and side, but by its more densely punctured thorax, with shorter posterior angles, and by the less parallel elytra: the last is probably a sexual character.

12. E. apicatus, niger, helvo-pubescens, thorace confertim punctato, elytris læte sanguineis, plaga utrinque apicali oblonga nigra, striis profundis punctatis, interstitiis convexis, disperse punctatis, antennis piceis (feminæ) articulo 3^io^ secundo fere duplo longiore. Long. ·35—·46.

Say, Trans. Am. Phil. Soc. 6, 170.

Ampedus melanopygus Germ. Zeitschr. 5, 161.

Northern portions of the United States. I have only females of this species, but from the relation which the joints bear to each other, the male probably has antennæ like the preceding species; the apical black spot of the elytra is well defined, and does not touch either the side or suture.

13. E. phœnicopterus, niger, helvo-pubescens, thorace confertim punctato, elytris sanguineo-ferrugineis, striis punctatis, interstitiis fere planis ruguloso-punctatis, antennis vix piceis, (feminæ) articulo 3^io^ secundo fere duplo longiore. Long. ·43—·5.

Ampedus phœnicopterus Germ. Zeitschr. 5, 161.

Oregon and Lake Superior. Having compared specimens, I have been convinced of their identity. This species is very closely allied to the last, but the colour of the elytra is more obscure, and without spots: the thorax is more convex and more rounded on the sides: the difference in the depth of the elytral striæ and the punctuation of the interstices is not as obvious as would appear in Germar's description: I find that there is some variation in this respect in different specimens, though the interstices are never as convex as in the preceding.

14. E. luctuosus, ater, griseo-pubescens, thorace confertim punctato, postice canaliculato, elytris striis profundis punctatis, interstitiis confertim rugose punctulatis, antennis articulo 3^io^ secundo vix longiore, pedibusque piceis. Long. ·43—·5.

Lake Superior, at Eagle Harbour. This species is extremely similar to the next, but the third joint of the antennæ in both sexes is much shorter than the fourth and hardly longer than the second. The elytra are less tapering, being almost parallel anteriorly, as in the preceding two species. The thorax is narrowed from the base, and moderately rounded on the sides: in the female it is a little broader than long, in the male its diameters are about equal.

15. E. s o c e r, ater, griseo-pubescens, thorace confertim punctato, postice subcanaliculato, elytris striis profundis punctatis, interstitiis subconvexis confertim punctatis, antennis nigris articulo 3to secundo fere duplo longiore, pedibus piceis. Long. ·52.

One specimen, Pennsylvania. The thorax is longer than wide, very slightly narrowed and not rounded from the base to the middle, then narrowed and broadly rounded to the tip: the elytra are slightly narrowed from the very base: the punctures of the interstices are close and distinct. Differs from the preceding by the third joint of the antennæ being longer than the second, and by the form of the thorax: from the next by the much shorter pubescence and also by the form of the thorax.

16. E. i m p o l i t u s, ater, longius helvo-pubescens, thorace breviusculo, confertim punctato, postice canaliculato, elytris striis profundis punctatis, interstitiis confertim rugose punctatis, antennis nigris, basi testaceis, articulo 3to secundo fere duplo longiore, pedibus ferrugineis. Long. ·47.

Melsheimer, Proc. Acad. Nat. Sc. 2, 180.

Pennsylvania, rare. The thorax is a little wider than long, narrowed and rounded from the very base; the punctuation is a little finer, and the pubescence considerably longer than in the preceding species. The elytra are slightly narrowed from the very base. The legs are rufo-testaceous, or ferruginous.

17. E. h e p a t i c u s, piceo-ater, helvo-pubescens, thorace breviusculo, confertim punctato, elytris striis minus profundis punctatis, interstitiis planiusculis subtilius rugose punctatis, antennis pedibusque fusco-testaceis articulo 3to secundo fere duplo longiore. Long. ·45.

Melsheimer, Proc. Acad. Nat. Sc. 2, 160.

Pennsylvania and Vermont. The antennæ are more slender than in the neighbouring species; the thorax is considerably rounded on the sides, but the narrowing is scarcely perceptible from the base to the middle; it is less convex than usual and not at all channelled posteriorly; the posterior angles in Dr. Melsheimer's type continue the line of the sides, while in my specimen they are slightly divergent. The elytra are parallel to the middle, very slightly narrower than the thorax; the striæ are not deep, the interstices are not convex, finely and not densely rugosely punctured.

18. E. m o l e s t u s, ater, helvo-pubescens, thorace oblongo antice angustato, confertim punctato, postice subcanaliculato, elytris antice parallelis, apice obtusiusculis, striis punctatis, interstitiis confertim rugose punctatis, antennis basi testaceis, articulis 2 et 3 subæqualibus, pedibus testaceo-piceis. Long. ·35.

A specimen found at Lake Superior; another with paler legs brought from Maine by Prof. Guyot. The thorax is a little longer than wide, narrowed and rounded before the middle, with the sides parallel posteriorly. The elytra are parallel as far as the middle, then obtusely rounded to the apex; the striæ are narrow and well defined; the interstices are not convex; the antennæ are strongly serrate, the third joint hardly longer than the second; the eleventh joint oval.

19. E. f u s c a t u s, ater, helvo-pubescens, thorace oblongo, antice angustato, punctato, elytris a basi subangustatis, striis punctatis, interstitiis rugose punctatis, antennis basi testaceis, articulis 2 et 3 subæqualibus, pedibus rufis. Long. ·3—·37.

Melsheimer, Proc. Acad. Nat. Sc. 2, 215.

Middle States. Differs from the preceding in the thorax not being channelled behind, and in the punctuation becoming finer near the base; also in the elytra being slightly narrowed from the base, and less obtuse at the apex, and in the interstices being less densely punctured. The antennæ are a little shorter than the thorax and strongly serrate.

20. E. nigricans, ater, helvo-pubescens, thorace punctato, postice canaliculato, elytris acutiusculis, striis punctatis, interstitiis remote rugose punctatis, antennis piceis articulis 2 et 3 subæqualibus, pedibus ferrugineis. Long. ·31.

Ampedus nigricans Germ. Zeitschr. 5, 176.

Elater testaceipes Mels. Proc. Acad. Nat. Sc. 2, 213.

Pennsylvania and New York. Differs from E. molestus by its less obtuse elytra, and from E. fuscatus by the punctuation of the thorax not being fine at the base, and by the dorsal channel being distinct posteriorly. In the specimens seen, the thorax is narrowed anteriorly from the middle, and is a little longer than wide; Germar describes the thorax as being "latitudine baseos subbrevior;" but this difference may be sexual.

21. E. ursulus, ater, nigro-pubescens, thorace punctato, postice subcanaliculato, elytris postice obtusioribus, striis punctatis, interstitiis rugose punctatis, antennis articulo 3^io^ secundo paulo longiore, pedibus rufo-piceis, vel nigro-piceis. Long. ·31.

Melsheimer, Proc. Acad. Nat. Sc. 2, 213.

Pennsylvania and New York. This species is readily distinguished from the preceding closely allied species by its pubescence being finer, and so dark coloured as to be almost invisible, unless viewed laterally; the thorax is a little longer than wide, and is narrowed almost from the base and rounded on the sides.

This species seems subject to variations: in the type the interstices of the elytra are sparsely punctured, and the feet dark rufo-piceous; in two other specimens the feet are black, and the elytra more densely rugous. I should have considered the type as Ampedus pedalis *Germ.* (Zeitschr. 5, 176,) but the thorax is not densely punctured, as required by his description.

22. E. lacustris, ater, griseo-pubescens, thorace punctato, antrorsum angustato, elytris basi late ferrugineis, striis punctatis, interstitiis subconvexis, disperse punctatis, antennis pedibusque testaceis, illis articulis 2 et 3 subæqualibus. Long. ·22.

One specimen, Lake Superior. The thorax is narrowed from the middle to the apex, and broadly rounded on the sides; it is scarcely longer than wide, the elytra are parallel anteriorly, obtusely rounded posteriorly; the antennæ are not longer than the thorax, which character would distinguish it from Ampedus pullus *Germ.* (Zeitschr. 5, 162.)

23. E. fusculus, ater, helvo-pubescens, thorace punctato, ante medium angustato, angulis posticis testaceis, elytris subtilius striatis, striis punctatis, interstitiis planis confertim punctatis, testaceis, sutura late infuscata, antennis pedibusque testacco-fuscis, illis articulis 2 et 3 æqualibus. Long. ·26.

Lake Superior, two specimens. The thorax is not longer than wide, and tolerably strongly rounded on the sides, which are parallel behind the middle. The elytra are parallel on the sides, and gradually somewhat obtusely rounded at the tip. The antennæ are as long as the thorax.

24. E. deletus, ater, nitidus, grisco-pubescens, thorace antrorsum angustato, subtiliter parce punctulato, elytris subtilius striatis, striis punctatis, interstitiis planis, punctatis, antennis pedibusque fusco-testaceis, illis articulis 2 et 3 æqualibus. Long. ·25.

Variat, elytris testacco-fuscis.

Lake Superior. Though the thorax is narrowed almost from the base, and is less rounded on the sides than in the preceding, the chief character for distinguishing them is found in the punctuation of the thorax, which is here much finer and more distant; the pubescence instead of being brown is dark gray, appearing almost black in certain lights. The form and sculpture of the elytra are as in E. fusculus.

One specimen from Eagle Harbour, Lake Superior, is absolutely the same in form as those above described; but the striæ of the elytra are deep and strongly punctured, and the antennæ and feet are yellowish testaceous. In the absence of other specimens, I cannot decide if it should rank as a distinct species.

25. E. mixtus, picco-niger, helvo-pubescens, thorace a medio antrorsum angustato, punctato, elytris parallelis, testacco-rufis, pone medium gradatim nigricantibus, striis subtilibus punctatis, interstitiis planis rugose punctatis, antennis pedibusque piceis, illis articulo 3^tio^ 2do sesqui longiore. Long. ·32.

Herbst, Käfer, 10, 54, tab. 164, fig. 9.

One specimen, Lake Superior. The antennæ are moderately long: the third joint, although not much more than half the size of the fourth, is larger than the second joint: the thorax is not longer than wide, is obliquely narrowed anteriorly, and but slightly rounded: the elytra are parallel anteriorly, and obtusely rounded posteriorly: the tarsi are testaceous.

26. E. miniipennis, niger, helvo-pubescens, thorace a medio antrorsum angustato, punctato, elytris parallelis, miniatis, striis profundis punctatis, interstitiis convexis, vix parce punctulatis, pedibus picco-testaceis, antennis piceis, basi testaceis, articulis 2 et 3 æqualibus 4to coniunctis longioribus. Long. ·25—·3.

Georgia, Maryland, and Lake Superior. In appearance resembles E. sanguinipennis, but is essentially different by the parallel obtuse elytra, and the light-coloured feet. The colour of the elytra is hardly as brilliant as in the next species.

27. E. sanguinipennis, niger, nitidus, helvo-pubescens, thorace remotius punctato, antrorsum angustato, elytris a basi postice angustatis, læte coccineis, striis profundis punctatis, interstitiis convexis parce punctulatis, tarsis testaceis, antennis nigris basi subtestaceis, articulis 2 et 3 subæqualibus, 4to coniunctis vix longioribus. Long. ·33.

Say, Journ. Acad. Nat. Sc. 3, 177; Trans. Am. Phil. Soc. 6, 173.

Ampedus sanguinipennis Germ. Zeitschr. 5, 160.

One specimen, Georgia; found also in the middle States.

28. E. palans, ater, nitidus, grisco-pubescens, thorace latitudine longiore, antrorsum angustato, læte sanguineo, remote subtilius punctato, postice subcanaliculato, angulis posticis prosternoque nigris, elytris striis profundis, punctatis, interstitiis convexis parce rugose punctatis, antennis articulo 3to paulo dilatato, 4to longitudine æquali. Long. ·26.

One specimen, Georgia. Care must be taken that this species is not confounded with the next, to which it bears an astonishing resemblance. On comparison, the thorax is different in form, being but little rounded on the sides: the punctuation is less dense, and

the disc is distinctly channelled posteriorly: the elytra are very slightly narrowed from the base: the third joint of the antennæ is very different in form, being as long as the fourth, though but slightly dilated.

29. E. collaris, ater, nitidus, brunneo-pubescens, thorace sanguineo, latitudine non longiore, a medio antrorsum angustato, sat dense punctato, postice obsolete canaliculato, prosterno nigro, elytris parallelis, griseo-pubescentibus, striis profundis punctatis, interstitiis subconvexis disperse punctatis, antennis articulis 2 et 3 subæqualibus, 4to coniunctis longioribus. Long. ·33.

Say, Annals of the Lyceum of Nat. Hist. New York, 1, 268.

Elater thoracicus ‡ Herbst, Käfer, 10, 51, tab. 162, fig. 8.

Ampedus collaris Germ. Zeitschr. 5, 172.

Middle and Southern States. Herbst seems to have confounded this species with a European Elater thoracicus *Fabr.* which is now placed in Cardiophorus. There are some naturalists who, finding that the species of the two authors fall into different genera, would retain both; a piece of deference to ancient authorities which can be shown only at the expense of good scientific morals, since it opens the way to carelessness. The only method of preserving nomenclature from even greater confusion than that in which it is already plunged, is to exclude decidedly, and without hesitation, every name founded upon error or misinterpretation of preceding authors. Dr. Harris thinks that the E. collaris is a species of Cratonychus, but as Say does not mention the serration of the ungues, it is safer to consider the present species, which agrees perfectly with his description, as really the one intended. In his remarks, (Trans. Am. Phil. Soc. 6, 174,) Say places E. collaris among the species with simple ungues, and it is hardly probable that, after his attention was turned to that character, he would have made an error in grouping the species.

30. E. rubricus, ater nitidus, longius helvo-pubescens, thorace a medio antrorsum angustato, nigro, basi late lateribusque sanguineo, punctato, elytris parallelis, striis profunde punctatis, interstitiis paulo convexis punctatis, pedibus picco-testaceis, antennis basi testaceis, articulo 3io 2ndo paulo longiore. Long. ·31—·34.

Say, Annals of Lyceum Nat. Hist. New York, 1, 261.

Middle and Eastern States. This species seems to resemble very much Ampedus concinnus *Germ.* (Zeitschr. 5, 170,) but the thorax is too strongly punctured, and the third joint of the antennæ is not twice as long as the second: in none of the specimens seen by me does the black spot of the thorax reach the base. In a specimen from Vermont, the thorax seems to be narrowed from the base, but as the form is not symmetrical, it must be considered as a distortion. The prosternum is always black; the under surface of the thorax is sometimes entirely red, sometimes almost black. In the male the last joint of the antennæ is slightly acuminate; in the female it is rounded.

31. E. obliquus, supra fusco-niger, longius cinereo-pubescens, thorace subtransverso, parcius punctulato, antice rotundatim angustato, margine omni testaceo, elytris subcuneatis, macula obliqua basali versus suturam latiore lutea, striis profunde punctatis, interstitiis parce punctatis, subtus rufescens, pectore infuscato, antennis fusco-testaceis, articulo 3to angusto 4to longitudine æquali. Long. ·20—·23.

Say, Trans. Am. Phil. Soc. 6, 174.

Ampedus scitulus Germ. Zeitschr. 5, 168.

Middle and Eastern States, rare. Germar says that this species differs from others by its longer and more strongly serrate antennæ. It is true that the antennæ are strongly serrate, but I find them of the same form in nearly all the species of the present division of the genus; while in E. luteus, the antennæ are still more strongly serrate. In my specimens, which are females, the antennæ are but little longer than the thorax; the specimen described by Germar is said to have antennæ half as long as the body, and is certainly a male. Dr. Harris thinks that this is E. stigma *Herbst*; a species placed in Limonius by Dejean, and which for the present it is safer to consider as indeterminate, or unknown.

32. E. areolatus, rufo-testaceus, cinereo-pubescens, thorace subtransverso, punctulato, antice rotundatim angustato, capite scutello elytrisque nigris, his macula obliqua basali, apiceque late rufo-flavis, striis profunde punctatis, interstitiis parce punctatis, antennis fuscis, basi testaceis, articulo 3^io^ angusto, 4to longitudine æquali. Long. ·18—·22.

Say, Journ. Acad. Nat. Sc. 3, 167.

Middle and Southern States, rare. The only differences between this and the preceding species are those of colour. I am very much disposed to regard them as varieties; if this view should finally prevail, the name areolatus has of course precedence.

Erichson has committed a very singular error in quoting Say's species under the genus Cardiophorus. (Germ. Zeitschr. 2, 321.) The species there described has no resemblance whatever to the present one, and is in reality Elater curiatus *Say*. (Trans. Am. Phil. Soc. 6, 173.)

33. E. luteolus, rufo-testaceus, longius flavo-pubescens, thorace subtransverso, antrorsum rotundatim angustato, parce punctulato, elytris subcuneatis, saturatioribus, striis profunde punctatis, interstitiis parce punctulatis, antennis articulis 2 et 3 subæqualibus maiusculis. Long. ·15.

One specimen. North Carolina, Dr. Zimmermann. This is the smallest species of the genus known to me; in form and structure it altogether resembles E. obliquus, except that the thorax is more regularly narrowed and rounded anteriorly, and that the second joint of the antennæ is very little shorter than the third; the specimen is a male, and has antennæ fully half as long as the body.

34. E. humeralis, elongatus, ater nitidus, subtiliter nigro-pubescens, thorace latitudine longiore, antrorsum angustato, vix rotundato, parcius punctato, elytris macula humerali quadrata sanguinea, parallelis, striis punctatis interstitiis vix convexis, rugose punctatis, antennis totis nigris, articulo 3^io^ triangulari 2^ndo^ sesqui maiore. Long. ·31.

Melsheimer, Proc. Acad. Nat. Sc. 2, 159.

Pennsylvania. I have only seen the type in Dr. Melsheimer's collection. The third joint of the antennæ, although dilated, is hardly one-half the size of the fourth. Germar's Ampedus xanthomus (Zeitschr. 5, 168) seems to agree nearly with this, but the size (·25 une.) is so different, that I cannot consider them as identical.

35. E. protervus, elongatus, ater, nitidus, cinereo-pubescens, thorace latitudine longiore, antrorsum a basi paulo angustato, lateribus parum rotundatis, sat dense punctato, elytris parallelis basi anguste et epipleuris sanguineis, striis punctatis, interstitiis subconvexis, rugose punctatis, antennis piceis, articulo 3^io^ 2^ndo^ paulo maiore, tarsis rufo-piceis. Long. ·4

Lake Superior. It is difficult to determine whether this should not be considered as E. semicinctus *Randall* (B. Journ. Nat. Hist. 2, 10;) but the expression "body considerably dilated," coupled with the observation that "it seems most nearly allied to E. discoideus," has induced me to refer Randall's description to No. 8 of this genus, above described. The thorax in this species is less narrowed in front than usual; the elytra are also parallel beyond the middle, then gradually narrowed to the tip.

36. E. stigmosus, elongatus, ater cinereo-pubescens, thorace latitudine longiore, antrorsum subangustato, lateribus antice subrotundatis, sat dense punctato, postice obsolete canaliculato, elytris macula hamata basali, humerum includente, alteraque utrinque transversa pone medium flavis: striis punctulatis interstitiis planis, rugose punctatis, pedibus antennarumque basi testaceis, his articulis 2 et 3 æqualibus. Long. ·21—·25.

Lake Superior, two specimens. A very distinct and pretty species; the yellow spots of the elytra are arranged in the following manner: a line from the middle of the base follows along the fourth interstice for one-third the length of the elytra; it there meets a broader line running obliquely inwards from below the humerus, and slightly dilated along the margin; the posterior spot is small, and situated one-third the entire length of the elytra from the apex; in the second specimen the hook formed by the junction of the two anterior lines is imperfect, and the posterior spot is larger, becoming almost round; the tibiæ and tarsi are much paler than the femora. The second and third joints of the antennæ together are not longer than the fourth.

37. E. rufilabris, elongatus, linearis, nigro-piceus fusco-pubescens, thorace latitudine fere sesqui longiore, antice vix angustato, ad apicem paulo rotundato, punctato, basi lutea, elytris basi anguste luteis, striis punctulatis, interstitiis confertim punctatis, pedibus flavo-testaceis, antennis elongatis piceis, basi testaceis, articulis 2 et 3 æqualibus 4to coniunctis brevioribus. Long. ·25—·32.

Germ. Ins. Nov. 47.

Ampedus rufilabris Germ. Zeitschr. 5, 169.

Middle and Southern States. The head is larger than usual, although there is not a great deal of difference in form between this and the two preceding species; this is, however, narrower and more parallel. The outline of the front is more rounded than usual, and the margin is slightly reflexed.

Blauta *Lec.*

Frons convexiuscula, paulo producta, margine rotundata, non impressa; labrum antice rotundatum; antennæ serratæ, 11-articulatæ, articulo 1mo mediocri, 2 et 3 parvis, hoc sesqui maiore, 11mo subconstricto: prosternum antice lobatum, mucrone postico leviter inflexo, sutura obliqua, subconcava, usque ad medium valde exarata; mesosternum non protuberans; coxæ posticæ laminis intus sensim et modice dilatatis, margine bisinuato, dente interno magno, acuto: tarsi pubescentes, articulo 1mo sequentibus duobus æquali, 2—4 sensim brevioribus, subtus breviter lobatis et spongiosis: 5to primo æquali, unguiculis simplicibus.

A curious, subcylindrical insect, which I am very much disposed to consider Ampedus cribrarius *Germ.* (Zeitschr. 5, 178;) but as it has the thorax a little longer than wide, and the antennæ very distinctly serrate, it is more proper to retain it as distinct from that spe-

cies. The posterior angles of the thorax are carinated, with the carina slightly diverging from the margin: the basal fissures are short and distinct.

1. B. c a u t a, subcylindrica, castanea, helvo-pubescens, capite thoraceque confertim punctatis, hoc latitudine paulo longiore, antrorsum subangustato, lateribus rectis apice paulo rotundatis, elytris striis profundis punctatis, interstitiis subconvexis punctatis. Long. ·55.

One specimen, Georgia. The sides of the thorax are not parallel, but converge slightly anteriorly: the posterior angles continue the line of the sides; they are straight considerably in front of the middle, then slightly rounded to the apex.

Cratonychus *Dej. Er.*

1. C. c o r t i c i n u s, linearis elongatus, parcius longe sordide pilosus, piceus, fronte concava, thorace latitudine longiore, antrorsum paulo angustato, lateribus rectis, grosse punctato, parcius in medio, postice canaliculato, angulis posticis productis divergentibus, elytris parallelis, striis punctatis vix impressis, interstitiis rugose punctulatis, antennis thorace sesqui longioribus, (maris sublanuginosis,) articulis 2 et 3 subæqualibus. Long. ·58.

Elater corticinus Say, Journ. Acad. Nat. Sc. 3, 174; Trans. Am. Phil. Soc. 6, 183.

One specimen, Georgia. The sides of the thorax are scarcely rounded at the anterior angles: the divergence of the posterior angles causes them to appear slightly concave: the carina is about one-third the length of the thorax and very near to the margin.

2. C. l o n g u l u s, linearis elongatus, piceo-niger griseo-pubescens, fronte concava, thorace latitudine longiore, antrorsum paulo angustato, lateribus rectis apice subrotundatis, grosse punctato, parcius in medio, angulis posticis divergentibus, postice canaliculato, elytris parallelis, striis punctatis haud vel vix impressis, interstitiis parce punctulatis, pedibus rufis, antennis, (maris lanuginosis,) articulo 3° secundo sesqui longiore. Long. ·4.

Four specimens, San Diego, California, all of which appear to be males: the antennæ are not much longer than the head and thorax, and are somewhat strongly serrate.

Found with them was a single female, having a complete resemblance in the form and sculpture of every portion of the body, except the thorax, which is brownish red, with the sides straight as far as the middle, then broadly rounded to the apex: the posterior angles are hardly divergent: the antennæ are formed as in the male, and finely pubescent.

3. C. m a c e r, elongatus fere linearis, testaceus, vel fuscus, longius pubescens, fronte concava, thorace latitudine longiore, antrorsum angustato, lateribus fere rectis, sat grosse punctato, parcius in disco, postice canaliculato, angulis posticis non divergentibus, elytris a basi subangustatis, striis punctatis, leviter impressis, interstitiis punctis paucis notatis, antennis pubescentibus thorace sesqui longioribus, articulo 3° 2do sesqui longiore. Long. ·43.

Georgia and New York. Easily distinguished by its very narrow body, not entirely linear as in the preceding, nor as strongly lanceolate as in the following.

4. C. c u n e a t u s, modice lanceolatus, fusco-piceus, densius fusco-pubescens, fronte concava, thorace latitudine subbreviore, antrorsum angustato, lateribus late vix rotundatis, disco minus dense sat grosse punctato, linea dorsali lævi antice obsoleta, elytris a basi angustatis, striis punctatis subimpressis, interstitiis disperse punctulatis, antennis (maris lanuginosis) thorace sesqui longioribus, articulo 3° 2do duplo maiore. Long. ·62.

Georgia. I have only males. The smooth but not impressed dorsal line distinguishes this from the allied species. The sides of the thorax are thickly, the disc less densely, punctured; the posterior angles have two distinct carinæ. In one specimen, which is possibly a distinct species, the thorax is less convex, and with the exception of the dorsal line is equally and densely punctured.

5. C. incertus, piceus, fusco-pubescens, fronte concava, thorace antrorsum a basi angustato, latitudine vix breviore, lateribus late rotundatis, crebre punctato, postice subcanaliculato, elytris subparallelis, striis impressis punctatis, interstitiis subtiliter rugose-punctulatis, antennis pedibusque castaneis, illis articulo 3^io 2^ndo duplo longiore, (maris lanuginosis, feminæ pubescentibus.) Long. ·61—·75.

Missouri Territory. The sides of the thorax in one male are nearly straight; in the females they are broadly rounded: the elytra are very slightly narrowed from the base in the males, while they are parallel in the females. This species is very similar to the next, and is only to be distinguished by the more gradually rounded sides of the thorax. The posterior angles are bicarinate.

6. C. decumanus, piceus, fusco-pubescens, fronte concava, thorace latitudine fere breviore, lateribus postice fere parallelis antice rotundatis, crebre grossius punctato, postice vix canaliculato, elytris parallelis, striis impressis punctatis, interstitiis punctulatis, antennis (maris longius, feminæ subtilius) pubescentibus, articulo 3^io 2^ndo duplo longiore. Long. ·68—·73.

Erichson, Germ. Zeitschr. 3, 104.

Maryland, Prof. Adams. Although differing but slightly in appearance from the preceding, the antennæ of the male are not covered with erect hairs, but with prostrate hairs, longer than those seen in the female. The inner carina of the posterior angles of the thorax is distinct.

One female differs in having the punctures of the interstices of the elytra very distinct.

7. C. clandestinus, niger, subtiliter cinereo-pubescens, fronte concava, thorace latitudine longiore, elytris vix latiore, lateribus fere parallelis antice late rotundatis, confertim subtilius punctato, postice breviter canaliculato, elytris parallelis, striis punctatis, interstitiis subtiliter rugose punctulatis, antennis lanuginosis piceis articulis 2 et 3 parvis æqualibus, pedibus rufis. Long. ·32—·37.

Erichson, Germ. Zeitschr. 3, 112.

Middle and Southern States.

8. C. secretus, niger, nitidus, pube subtili atro-grisea vix conspicua vestitus, fronte late concava, fortius marginata, thorace latitudine longiore lateribus parallelis antice rotundatis, minus convexo, disperse punctato, postice breviter canaliculato, elytris thorace vix angustioribus parallelis, striis profunde punctatis, interstitiis disperse punctulatis, pedibus antennisque rufis, his breviter lanuginosis, articulo 3^io 2^ndo paulo longiore. Long. ·32—·41.

Georgia. The carina of the posterior angles of the thorax is very long, very close to the margin, and parallel with it. The form of the thorax causes this species to resemble the preceding, but its characters are very different. It, however, forms the passage from the species having the front concave, to those with the front flattened or convex.

9. C. ignobilis, fusco-piceus, elongatus, grisco-pubescens, fronte plana, margine subreflexo, thorace latitudine subbreviore antrorsum paulo angustato, lateribus rectis, minus convexo, sat dense punc-

tato, carina angulari margini valde approximata, elytris a basi attenuatis, punctis magnis seriatis, interstitiis parce punctulatis, antennis elongatis, valde serratis, articulo 3^io^ secundo sesqui longiore, pedibus castaneis. Long. ·41.

Melanotus ignobilis Mels. Proc. Acad. Nat. Sc. 32, 152.

A very distinct species, of which I have seen only the single male found in Pennsylvania by Dr. Melsheimer: the pubescence of the antennæ is very short, but dense and erect.

10. C. d e p r e s s u s, modice elongatus, piceus, griseo-pubescens, fronte plana, submarginata, thorace latitudine non breviore, antrorsum angustato, lateribus rectis, antice vix rotundatis, parce distincte punctato, minus convexo, carina angulari margini valde approximata, elytris a basi attenuatis striis impressis subtilius punctatis, interstitiis vage punctulatis, antennis (maris lanuginosis, femine longius pubescentibus) articulo 3^io^ 4to vix breviore, pedibus rufis. Long. ·36—·4.

Ctenonychus depressus Mels. Proc. Acad. Nat. Sc. 2, 151.

Middle and Southern States, not rare. In the male the elytra are more attenuated, and almost straight on the sides; in the female the sides are slightly rounded.

11. C. a n g u s t a t u s, rufo-testaceus, nitidus, modice elongatus subtiliter griseo-pubescens, fronte plana, thorace minus convexo latitudine vix breviore, antrorsum angustato, lateribus rectis apice paulo rotundatis parce subtilius punctato, carina angulari elongata margini valde approximata, elytris striis vix impressis distincte punctatis, interstitiis vix subtiliter punctulatis, antennis articulo 3^io^ 4to paulo breviore. Long. ·36.

Erichson, Germ. Zeitschr. 3, 113.

Ctenonychus testaceus Mels. Proc. Acad. Nat. Sc. 2, 151.

One specimen from Pennsylvania in Dr. Melsheimer's collection, which agrees with Erichson's description in every respect except in being rather paler coloured.

12. C. t r a p e z o i d e u s, fusco-piceus, longius griseo-pubescens, fronte fere plana, utrinque paulo impressa, thorace latitudine breviore, antrorsum paulo angustato, parce grossius punctato, lateribus rectis, carina angulari margini approximata, elytris subparallelis, striis impressis subtilius punctatis, interstitiis parce punctatis, pedibus rufis, antennis picco-rufis, (maris sublanuginosis) articulo 3^io^ 2^ndo^ duplo longiore. Long. ·31—·36.

New Jersey, Mr. Guex. Similar in characters to C. d e p r e s s u s, but somewhat less elongated, with a shorter thorax; the third joint of the antennæ is intermediate in size to the second and fourth.

13. C. t æ n i c o l l i s, niger, minus subtiliter albido-pubescens, fronte subimpressa, marginata, thorace latitudine non breviore, minus convexo, lateribus postice parallelis, antice rotundatis, parce punctato, margine omni læte rufo, elytris parallelis, striis punctatis, vix impressis, interstitiis parce fortius punctatis, margine basali pedibusque læte rufis, antennis picco-rufis longius pubescentibus, articulis 2 et 3 parvis æqualibus. Long. ·35.

One specimen, Philadelphia, Mr. Schaffhirt. Peculiar from the very quadrate form of the thorax; the inflexed portion of the thorax is red, the prosternum black; the carina of the posterior angles of the thorax is short, and diverges a little from the margin; the antennæ do not reach beyond the base of the thorax.

14. C. L e o n a r d i, niger, subtilius cinereo-pubescens, fronte paulo convexa, thorace læte sanguineo, latitudine vix longiore, convexiusculo antrorsum angustato, et lateribus rotundato, punc-

tato, parcius in disco, postice subcanaliculato, elytris subparallelis, striis punctatis, interstitiis parce distinctius punctatis, pedibus rufo-piceis, antennis (maris lanuginosis, feminæ pubescentibus) articulis 2 et 3 parvis æqualibus. Long. ·12.

Georgia, Pennsylvania, and New Hampshire; for a fine specimen from the last locality, collected by the Rev. Mr. Leonard, I am indebted to Dr. Harris. The whole appearance is precisely that of Elater rubricollis, but the thorax is brighter coloured. The prosternum is black; the carina of the posterior angles of the thorax is one-fourth the length of the thorax, and diverges slightly. Dr. Harris considers this as Elater collaris *Say:* for the reasons which compel me to differ with him, see the remarks under species (29) of Elater.

15. C. s c r o b i c o l l i s, piceus, elongatus, fusco-pubescens, fronte minus convexa, thorace latitudine sublongiore, antrorsum sensim angustato, lateribus vix rotundatis, canaliculato, grosse sat dense punctato, elytris striis punctatis, interstitiis perparce punctatis, antennis (maris lanuginosis, feminæ pubescentibus) articulis 2 et 3 subæqualibus. Long. ·6—·67.

Middle States and Lake Superior. Brownish piceous, not densely clothed with brown pubescence. Head coarsely and densely punctured, front slightly flattened, not impressed. Antennæ longer than the head and thorax; pubescence in the male erect, in the female depressed; third joint hardly larger than the second. Thorax a little longer than wide, not wider than the elytra, sides oblique from the base, and hardly rounded; disc very coarsely, tolerably densely punctured, dorsal line impressed posteriorly, obsolete before the middle; posterior angles continuing the line of the side, carina extending almost to the middle, internal carina wanting. Elytra slightly narrowed from the base in the male, nearly parallel for two-thirds the length in the female, striæ not deep, coarsely punctured, interstices with a few fine punctures; feet very dark castaneous.

A male specimen from New York differs in having the sides of the thorax nearly parallel behind the middle, and considerably rounded in front; if this should not be an accidental distortion, it would seem to indicate a different species; but after careful comparison no other difference could be discovered.

16. C. i n æ q u a l i s, piceus, fusco-pubescens, fronte convexa, thorace subtransverso, postice subcanaliculato, lateribus subangulato, grosse sat dense punctato, elytris subparallelis, seriatim punctatis, interstitiis distinctius parce punctatis, antennis (feminæ) pubescentibus articulo 3^io^ secundo sesqui maiore. Long. ·70.

One specimen from Point Kewenaw, Lake Superior. Brownish piceous, not densely clothed with brown pubescence. Head coarsely densely punctured, convex, scarcely impressed. Antennæ longer than the head and thorax; third joint much smaller than the fourth, and one-half larger than the second. Thorax as wide as the elytra, a little broader than long, sides behind the middle almost parallel, then strongly narrowed to the apex, and almost angulated on the sides; disc very coarsely and tolerably densely punctured, slightly channelled posteriorly; posterior angles diverging from the line of the side; carina extending nearly midway from the angle to the anterior margin, internal carina hardly visible; elytra nearly parallel, narrowed for the posterior third of their length; striæ not impressed, composed of well defined lines of punctures; interstices flat, distantly and strongly punctured; beneath, uniform piceous brown; legs castaneous.

17. C. glandicolor, castaneus, fusco-pubescens, fronte minus convexa, thorace latitudine vix longiore, a basi sensim angustato, lateribus rectis ad apicem subito rotundatim angustatis, postice subcanaliculato, parce grosse punctato, elytris subparallelis, striis punctatis, interstitiis planis parce punctatis, antennis (feminæ) pubescentibus, articulis 2 et 3 æqualibus. Long. ·70.

Melanotus glandicolor Mels. Proc. Acad. Nat. Sc. 2, 152.

One specimen from Pennsylvania in Dr. Melsheimer's collection. This species is very distinct by the form of the thorax, the sides of which are perfectly straight and oblique from the tip of the posterior angles to within one-sixth of the apex, where they are suddenly rounded; the carina of the posterior angle is one-third the length of the thorax.

18. C. fissilis, fusco-piceus, brunneo-pubescens, fronte margine paulo reflexo, parum producto, thorace elytris latiore, latitudine paulo longiore, antrorsum valde angustato, lateribus rotundatis, angulis posticis bicarinatis non divaricatis, sat grosse punctato, non canaliculato, elytris a basi attenuatis, seriatim punctatis, interstitiis parce punctatis, et rugosis, antennis articulo 3° sequente vix breviore. Long. ·56—·62.

Cratonychus laticollis Erichson, Germ. Zeitschr. 3, 102.

? Elater brevicollis Herbst, Käfer, 10, 46, tab. 162, fig. 3.

Cratonychus ochraceipennis Melsheimer, Proc. Acad. Nat. Sc. 2, 150.

Cratonychus sphenoidalis Melsheimer, Proc. Acad. Nat. Sc. 2, 150 (teste Melsheimer.)

Elater cinereus‡ (*fissilis*) Say, Trans. Am. Phil. Soc. 6, 183.

Elater (*Melanotus*) *cinereus*‡ Harris, Ins. Injurious to Vegetation 2nd ed. 48.

Abundant in the Middle and Southern States. Easily distinguished by the thorax being wider than the elytra, and not channelled. C. ochraceipennis is an immature specimen, in a bad condition. The posterior angles of the thorax in this species are distinctly bicarinate, and the basal fissures very distinct.

19. C. communis, fuscus, brunneo-pubescens, fronte non concava, paulo producta, thorace elytris sublatiore, latitudine non longiore, antrorsum valde angustato, angulis posticis bicarinatis, sat grosse punctato, postice canaliculato, elytris striis subimpressis punctatis, interstitiis minus dense rugose punctulatis, antennis articulo 3° sequente paulo breviore. Long. ·45—·55.

Dejean, Cat. ed. 3^e^: Erichson, Germ. Zeitschr. 3, 102.

Elater communis Gyllenhal, Schönh. Syn. Ins. 3, Ap. 138, (1817:) Say, Tr. Am. Phil. Soc. 6, 184.

Perimecus communis Kirby, Fauna Bor. Am. 148.

Elater (*Melanotus*) *communis* Harris, loc. cit. 48.

Elater cinereus Weber, Obs. Ent. 77, (1801.)

Abundant, as far as Nebraska. The last synonym is usually given to the preceding species, but, as Weber says, "Thorax punctatus basi canaliculatus," it cannot be there placed. His name has properly priority; but as many entomologists will refuse to adopt the view here given, (which has indeed already been advanced by Kirby,) the change of name would only lead to confusion.

One specimen from New Orleans, given me by Dr. Schaum, has the front moderately deeply concave: the thorax appears a little less convex, and more deeply channelled; but there does not appear sufficient reason to separate it.

20. C. exuberans, fusco piceus, brunneo pubescens, fronte non concava, paulo producta, thorace

latitudine longiore, antrorsum modice angustato, lateribus latius rotundatis, sat grosse punctato, angulis posticis bicarinatis, elytris a basi angustatis, striis punctatis subimpressis, interstitiis parce punctulatis, pedibus obscure ferrugineis, antennis articulo 3^io^ sequente paulo breviore. Long. ·53.

Two specimens, Santa Fe, collected by Mr. Fendler. This species is related to the two preceding, but differs by its narrower form, the thorax being proportionally longer, and not wider than the elytra, less narrowed in front, and less rounded on the sides.

21. C. parumpunctatus, nigro-piceus, cinereo-pubescens, fronte non concava, thorace latitudine paulo longiore, antice præcipue versus apicem magis angustato, lateribus rotundatis, parce modice punctato, postice subcanaliculato, elytris a basi angustatis, striis punctatis, paulo impressis, interstitiis parce punctulatis, pedibus antennisque ferrugineis, his articulo 3^io^ sequente paulo breviore. Long. ·45.

Melsheimer, Proc. Acad. Nat. Sc. 2, 150.

Middle States. This species has very much the appearance of C. communis, but is darker coloured, and has the punctures of the thorax somewhat smaller, and much less dense: even at the sides they are not at all confluent; the posterior angles of the thorax do not appear bicarinated; otherwise there is no special difference.

22. C. verberans, fuscus, cinereo-pubescens, fronte non concava, thorace latitudine non longiore, antrorsum valde angustato, lateribus rotundatis, parce modice punctato, angulis posticis vix bicarinatis, elytris a basi angustatis, striis punctatis subimpressis, interstitiis parce punctulatis, antennis pedibusque fusco-testaceis, illis articulo 3^io^ sequente sesqui minore. Long. ·39—·47.

Two specimens, Maryland. Resembles exactly C. communis, but the thorax is less rounded on the sides, and less densely punctured: there is no trace of a dorsal channel: the inner one of the carinæ of the posterior angles is less distinct, and the third joint of the antennæ is proportionally smaller, being about intermediate in size between the second and fourth.

23. C. emissus, longior, fuscus, cinereo-pubescens, fronte non concava, thorace latitudine non longiore, lateribus parallelis, antice rotundatis, modice punctato, densius ad latera, angulis posticis bicarinatis, elytris a basi subangustatis, striis punctatis subimpressis, interstitiis parce punctatis, antennis pedibusque testaceis, illis articulo 3^io^ sequente sesqui minore. Long. ·41.

One specimen, Georgia. More cylindrical than the preceding, with the elytra less narrowed posteriorly, and easily distinguished by the sides of the thorax being nearly parallel for three-fourths of their length. The punctures of the thorax are finer and more numerous than in the next species.

24. C. infaustus, picco-fuscus, longior, cinereo-pubescens, fronte non concava, thorace latitudine longiore, lateribus rectis, paulo convergentibus, antice rotundatis, parce punctato, elytris a basi angustatis, striis impressis punctatis, interstitiis parce punctulatis, pedibus antennisque castaneo-rufis, his articulo 3^io^ sequente subbreviore. Long. ·46.

Georgia. The straight, slightly converging sides of the thorax, rounded only near the apex, will distinguish this species: the posterior angles have only one carina.

25. C. cribulosus, fuscus, longius cinereo-pilosus, fronte non concava, thorace latitudine non longiore, antrorsum angustato, lateribus (maris fere rectis) feminæ rotundatis, cribratim punctato,

densius ad latera, elytris a basi subangustatis, striis impressis punctatis, interstitiis parce punctulatis, antennarum articulo 3to sequenti æquali, pedibusque fusco-testaceis. Long. ·37—·43.

Nebraska Territory. The difference in the form of the thorax of the two sexes is very great: in the male the sides converge regularly, with scarcely any curvature; in the female the disc is more convex, and the sides are considerably rounded, especially in front: the third joint of the antennæ is wider than usual, and nearly as wide as the fourth.

26. C. pertinax, picco-niger, parce longius cinereo-pilosus, fronte subconcava, thorace latitudine subbreviore, convexo, lateribus postice parallelis, ante medium valde rotundatis, parce punctato, punctis in medio fere obsoletis, postice canaliculato, elytris lateribus parallelis, postice oblique angustatis, striis punctatis vix impressis, interstitiis parce subtiliter punctulatis, antennis pedibusque rufis, illis articulo 3to sequente non breviore. Long. ·42.

Elater pertinax Say, Trans. Am. Phil. Soc. 6, 185.

Massachusetts and Georgia. An easily recognised species: the punctures of the thorax, anteriorly and at the sides, are tolerably large; in the middle they are almost obsolete.

27. C. dubius, picco-niger, cinereo-pubescens, fronte non concava, thorace latitudine non breviore, lateribus rectis, convergentibus, apice rotundatis, parce punctato, subtilius ad medium, postice canaliculato, elytris antice fere parallelis, striis punctatis vix impressis, interstitiis rugose punctulatis, pedibus antennisque rufis, his articulo 3to sequente non breviore. Long. ·33.

One specimen, New York. The deep posterior dorsal channel, and the fine punctures of the interstices of the elytra will distinguish this from the next species: it may possibly be the male of the preceding species, but there is no evidence of it except the general similarity of sculpture: the pubescence is denser and not so long: the thorax, however, bears pretty much the same relation in the two species as in the two sexes of C. cribulosus.

28. C. tenax, picco-niger, cinereo-pubescens, fronte non concava, thorace latitudine longiore, antrorsum subangustato, lateribus antice paulo rotundatis, parce æqualiter punctato, postice vix obsolete canaliculato, elytris striis punctatis, interstitiis minus subtiliter punctatis, pedibus antennisque rufis, his articulo 3to sequente paulo breviore. Long. ·3—·35.

Elater tenax Say, Trans. Am. Phil. Soc. 6, 185.

Middle and Southern States. The punctures of the interstices of the elytra are as large as those of the striæ, and will distinguish this from all other species here described. The striæ in one specimen are tolerably deep; in two others they are not impressed. The elytra in the male are narrowed slightly from the base; in the female they appear nearly parallel.

29. C. americanus, fuscus, cinereo-pubescens, fronte non concava, paulo producta, thorace latitudine non longiore, antrorsum magis angustato, lateribus ante medium rotundatis, postice breviter canaliculato, elytris a basi angustatis, striis fortius punctatis, non impressis, interstitiis parce punctulatis, antennis articulo 3to secundo æquali. Long. ·28—·35.

Erichson, Germ. Zeitschr. 3, 114.

Elater americanus Herbst, Käfer, 10, 71; tab. 165, fg. 2.

A very common species: the punctures of the thorax are hardly smaller at the middle: the small size of the third joint of the antennæ will distinguish it from any with which it is liable to be confounded: Erichson mentions neither this, nor the posterior dorsal chan-

nel, which is, however, very short. The thorax is more convex in the female, and more rounded on the sides than in the male.

30. C. insipiens, elongatus, testaceus, cinereo-pubescens, fronte non concava, paulo producta, thorace latitudine longiore, lateribus antice late rotundatis, minus dense punctato, postice canaliculato, elytris subparallelis, striis punctatis impressis, interstitiis punctulatis, antennis articulo 3° sequente paulo breviore. Long. ·23.

Elater insipiens Say, Trans. Am. Phil. Soc. 6, 184.

Southern States. Distinguished from the following by the dorsal channel of the thorax, and its rounded sides.

31. C. tenellus, elongatus, testaceus, cinereo-pubescens, fronte non concava, paulo producta, thorace latitudine longiore, lateribus rectis obliquis, minus convexo, minus dense punctato, non canaliculato, elytris a basi subangustatis, striis punctatis impressis, interstitiis parce punctulatis, sutura late fuscescente. Long. ·18—·23.

Erichson, Germ. Zeitschr. 3, 114.

Georgia. The darker suture gives this insect somewhat the appearance of Adrastus recticollis, but a very slight glance enables them to be separated.

32. C. oregonensis, nigro-piceus, longior, cinereo-pubescens, fronte non concava, vix producta, thorace latitudine longiore, convexiusculo, lateribus obliquis ad apicem rotundatis, angulis posticis divaricatis, sat grosse, lateribus densius punctato, postice canaliculato, elytris fere parallelis, striis punctatis vix impressis, interstitiis parce punctulatis, pedibus antennisque piceis, his articulo 3^io^ sequenti sesqui breviore. Long. ·48.

One specimen, Oregon, Col. M'Call. Sufficiently distinct from any of those above described, and resembling perhaps most nearly C. infaustus, but having the thorax more densely punctured and more oblique on the sides, and the third joint of the antennæ hardly more than half the size of the fourth, and only one half larger than the second.

33. C. longulus, testaceo-fuscus, elongatus, cinereo-pubescens, fronte non concava, thorace latitudine longiore, lateribus obliquis antice vix rotundatis, parce subtiliter punctato, postice breviter canaliculato, elytris fere parallelis striis punctatis subimpressis, interstitiis parce subtiliter punctatis, antennis articulo 3^io^ 2^ndo^ sesqui longiore. Long. ·37.

Georgia. My specimens are in bad condition. The third joint of the antennæ is intermediate in length between the second and fourth: the feet are paler than the body.

34. C. sagittarius, fuscus, vel testaceus, elongatus, cinereo-pubescens, fronte subconcava, apice subangulata, thorace minus convexo, latitudine non longiore, antrorsum angustato, lateribus antice late rotundatis, postice breviter canaliculato, parcius sat grosse punctato, elytris a basi angustatis, seriatim punctatis, interstitiis parce punctulatis, antennis articulo 3^io^ secundo sesqui longiore, pedibus pallidioribus. Long. ·54.

Middle States, rare. This and the next species seem to differ from all the preceding ones in having the clypeus almost angulated at the apex, although not as convex as in the species of Elater: from C. corticinus, macer, and exuberans, which alone resemble it in general form, it is easily distinguished by the characters above given.

35. C. paradoxus, elongatus, nigro-piceus, cinereo-pubescens, fronte subconcava, apice suban-

gulata, thorace minus convexo, antrorsum valde angustato, lateribus rotundatis, (vel potius ad medium obsolete angulatis,) carina angulari elongata, minus dense sat grosse punctato, elytris a basi angustatis, parce subtilius punctatis, striis internis obliteratis, antennis pedibusque rufis, illis articulo 2do 3^tioque^ æqualibus. Long. ·6.

Melanotus paradoxus Melsheimer, Proc. Acad. Nat. Sc. 2, 152.

One specimen from Pennsylvania, in Dr. Melsheimer's collection. The sides of the thorax are so obtusely angulated, that they may almost be called rounded: the outer striæ of the elytra are punctured and slightly impressed: the inner ones are reduced to small punctures, which are confused with those belonging to the interstices; the thorax has a very slight and short impression at the middle of the base. This species agrees accurately with C. p r o l i x u s *Er.* (Germ. Zeitschr. 3, 91) from Mexico, except that the breast and abdomen are not castaneous.

Besides these, there are described as occurring in North America, the following species, which I do not possess, or cannot identify with certainty.

C. c a s t a n i p e s Er. Germ. Zeitschr. 3, 95. *Perimecus fulvipes* Kirby, Fauna Bor. Am. 148.
C. s p a d i x Er. Germ. Zeitschr. 3, 103. *? C. cuneatus* Lec.
C. a b d o m i n a l i s Er. Germ. Zeitschr. 3, 104.
C. v e t u l u s Er. Germ. Zeitschr. 3, 105.
Perimecus s i m i l i s Kirby, Fauna Bor. Am. 149.

Monocrepidius *Esch. (emend.)*

Frons paulo convexa, antice rotundatim marginata, margine prominulo: mandibulæ parvæ, apice subemarginatæ: palpi articulo ultimo triangulari, oblique truncato, acuto: antennæ parum serratæ, articulo primo elongato, 2 et 3 sequentibus angustioribus, 4to coniunctis longioribus: prosternum antice lobatum, mucrone postice non inflexo, sutura laterali recta, antice haud, vel vix excavata: mesosternum non protuberans: coxæ posticæ laminis intus subito modice dilatatis, dente interno magno, rotundato: tarsi pubescentes, articulo 1mo sequentibus duobus æquali, 4to subtus sæpe lobato, in (C.) autem simplici: 5to longiore, unguiculis integris.

In this genus I include several species, placed by Germar in his second division of Cryptohypnus, with which they have very little relation: they accord nearly with Elater, and seem to differ only in having the front less convex and not angulated, the first joint of the antennæ elongated, and the internal tooth of the posterior coxæ rounded. I was at first inclined to consider the species like El. dorsalis, in which the tarsi are not lobed, as a distinct genus; but finding no other difference, and seeing, moreover, that in the species with lobed tarsi, there is no constancy in the form of the prolongation, it appears more natural to consider them as forming one natural genus, in which, as in many others of this tribe, the form of the fourth joint of the tarsi is variable: the posterior angles of the thorax are carinate, produced and sharp: basal fissures none.

Our species may be grouped as follows:—

A. Tarsi articulo 4to lobato, lobo valde dilatato . . . . Sp. 1—3.
B. Tarsi articulo 4to lobato, lobo angusto, (frons convexior:) . . Sp. 4—8.
C. Tarsi articulo 4to non lobato, (frons convexior;) . . . Sp. 9—14.

The latter division differs from Cryptohypnus, by the prosternum not being dilated in the middle, by the tarsi not being furnished with long bristles, and by the coxal plates being less dilated.

A. *Tarsi articulo 4to lobo dilatato instructo.*

1. M. l i v i d u s, fuscus pube densa pallide cinereo-fusca vestitus, thorace elongato, antrorsum angustato, lateribus late rotundatis, angulis posticis divergentibus, elytris striis punctatis, antennis testaceis, pedibus pallidis. Long. ·5—·7.

Elater lividus De Geer, Ins. 4, 162; tab. 18, fig. 13.

Elater castanipes‡Herbst, Käfer, 10, 23; tab. 160, fig. 5.

Elater lobatus Say, Journ. Acad. Nat. Sc. 3, 175; Trans. Am. Phil. Soc. 6, 174.

Monocrepidius lobatus Germ. Zeitschr. 1, 228.

Middle and Southern States. De Geer's figure and description cannot possibly refer to any other North American species: in a report upon the Coleoptera described by Beauvois, by M. Chevrolat, (Ann. Ent. Soc. France, Sept. 1852,) the name of De Geer is given to Elater elongatus *Beauv.*, a species mentioned as occurring in Hayti: as, however, De Geer states that his specimens came from Pennsylvania, it is obviously imprudent to apply his specific name to a West Indian species, until specimens from different localities have been compared, and their identity fully shown. The female is larger and more robust than the male, and has the sides of the thorax more rounded anteriorly. Germar places this among the species that have the elytra armed with an apical spine, but there is no such character to be seen in any of my specimens.

2. M. a v e r s u s, fuscus, elongatus, pube densa subcinerea brevissima vestitus, thorace infra flavo-marginato, elongato, lateribus vix rotundato, basi flava, angulis posticis non divaricatis, elytris striis punctatis, scutello, antennis, pedibusque flavo-testaceis. Long. ·36.

Georgia, rare. The body is entirely, finely and densely punctulate, as in the preceding species; the pubescence is very short and depressed, hardly altering the general colour of the insect.

3. M. s u t u r a l i s, fuscus, tenuiter cinereo-pubescens, thorace testaceo, linea dorsali fusca, elongato, lateribus late rotundatis, punctato, elytris parallelis, testaceis, vitta communi suturali ad basin et versus apicem latiore, margineque pone medium fuscis, striis punctatis, interstitiis subtilissime punctulatis, antennis pedibusque flavis. Long. ·27.

A specimen from Alabama, communicated by Dr. Harris, under the name adopted. This species is very distinct from the two preceding by the distinct punctures of the thorax. The head is fuscous, with the palpi and antennæ pale yellow. The under surface is fuscous, with the exception of the feet, the anterior margin of the prosternum, and the inflexed portion of the prothorax, which are testaceous yellow.

B. *Tarsi articulo 4to lobo angusto, (frons convexior.)*

4. M. s o r d i d u s, fuscus pube subtili sordida dense vestitus, thorace elongato, convexiusculo, lateribus late rotundato, punctato, angulis posticis pallidioribus subdivergentibus, elytris striis punctatis, interstitiis vix subtilissime punctulatis, antennis articulo 3^io^ 2^ndo^ longiore, testaceis, palpis pedibusque flavis. Long. ·31—·37.

Two specimens found on the Gila River, New Mexico. This is a moderately stout species, intermediate in form between the slender M. vespertinus and the other species of this group: the oblique side of the last triangular joint of the palpi is straight, so that those organs appear more acute at the tip than in the other species.

5. M. v e s p e r t i n u s, elongatus infra testaceus, supra fuscus, cinereo-pubescens, thorace latitudine longiore, punctulato, vittis duabus dilatatis nigro-fuscis, scutello testaceo, elytris vitta discoidali testacea, pone medium sæpissime interrupta, striis obsolete punctatis, antennis articulis 2 et 3 subæqualibus. Long. ·27—·40.

Dej. Cat. p. 98.

Elater vespertinus Fabr. Syst. El. 2, 240: Herbst, Käfer, 10, 131: Say, Tr. Am. Ph. Soc. 6, 177.

Elater finitimus Say, Trans. Am. Phil. Soc. 6, 179.

Monocrepidius serotinus Germ. Zeitschr. 1, 227.

Middle and Southern States. Varies very much both in size and colour: the thorax is occasionally black, with a narrow margin and vitta testaceous: the type with the elytral vitta entire and uniform is rare; the only specimen I have seen was given me by Mr. Guex: the vitta is sometimes reduced to a small humeral spot, one about the middle, and a less distinct one towards the tip. The thorax is longer, less narrowed in front, and much less rounded on the sides in the male than in the female: in both sexes the posterior angles are slightly divergent. El. finitimus *Say*, from a type in Dr. Harris' collection, is a dark variety of this species.

6. M. a u r i t u s, crassiusculus, fuscus, subtiliter pubescens, thorace convexo, ante medium angustato, angulis posticis vix divergentibus, confertim punctato, testaceo, nigro-bimaculato, (sæpe nigro, angulis posticis vittaque obsolete rufo-testaceis,) scutello sæpe testaceo, elytris macula utrinque basali, (ad medium sæpe extensa,) alteraque apicali rufo-testaceis, (sæpe obsoletis,) striis antice punctatis, interstitiis subtilissime punctulatis, pedibus testaceis, antennis basi pallidioribus, articulis 2 et 3 subæqualibus, 4to coniunctis longioribus. Long. ·2—·29.

Germ. Zeitschr. 5, 148, 190.

Elater auritus Herbst, Käfer, 10, 145.

Oophorus crassicollis Melsheimer, Proc. Acad. Nat. Sc. 2, 214.

New York, Georgia, Missouri Territory, Lake Superior. Extremely variable in colour: some specimens being testaceous above, with merely the head, margin of the elytra, and narrow posterior fascia blackish, while others are entirely black: these pass insensibly into each other, so that no well defined varieties can be separated. In Melsheimer's catalogue of described Coleoptera of the United States, his *O. crassicollis* is erroneously placed under Cryptohypnus, but on inspecting the typical specimen I found the tarsal lobe very distinct. The male differs from the female by the thorax being longer and less rounded on the sides.

7. M. b l a n d u l u s, mollice elongatus, parce flavo-pubescens, fuscus, thorace testaceo, fusco bivittato, latitudine longiore, a basi antrorsum angustato, lateribus vix rotundatis, punctis minutis et maioribus intermixtis sat dense punctato, elytris testaceis postice gradatim angustatis, margine suturaque postice latiore fuscis, striis antice valde punctatis, interstitiis convexis, vix subtiliter punctulatis, pedibus antennisque flavis, his articulis 2 et 3 æqualibus, coniunctis 4to longioribus. Long. ·19.

One male specimen, Georgia. Intermediate in form between M. vespertinus and M.

auritus, and easily distinguished from both by the punctuation of the thorax being composed of large and small points intermixed: a large series of specimens would undoubtedly show great variations in colour.

8. M. b e l l u s, crassiusculus, niger, flavo-pubescens, thorace distinctius punctato, linea dorsali angulisque posticis brevibus testaceis, elytris lineolis pluribus maculaque ante apicem testaceis, striis antice valde punctatis, interstitiis subtilissime punctulatis, pedibus antennisque flavis, his extrorsum crassioribus, articulis 2 et 3 æqualibus, 4to vix longiore. Long. ·14—·16.

Dej. Cat. p. 98.

Elater bellus Say, Journ. Acad. Nat. Sc. 3, 168.

Cryptohypnus bellus Germ. Zeitschr. 5, 147.

Abundant in the middle and Western States. Although Germar affirms positively that the fourth tarsal joint is not lobed, I find no difficulty in distinguishing the appendage, when it is not obscured by dust; it seems, in proportion to size, quite as distinct as in M. auritus.

C. *Tarsi articulo* 4to *non lobato; frons convexa.*

9. M. c o m i s, testaceus, subtiliter longius pubescens, capite piceo, thorace latitudine longiore antice angustato, et lateribus rotundato, sat dense subtilius punctato, vitta dorsali sæpe dilatata picea, elytris striis subtilibus punctatis, interstitiis vix subtilissime punctulatis, vitta dorsali antice abbreviata sæpissime cum sutura confluente, fasciaque postica nigro-piceis, postpectore abdomineque piceis. Long. ·22—·3.

California: found at San Francisco and San Jose. This species resembles, in appearance, M. dorsalis, but is at once distinguished by the finer punctures of the thorax, and the less deep and less strongly punctured striæ of the elytra: the pubescence is longer and denser, although not less fine. The general form of the markings of the elytra is that of M. dorsalis, but the dorsal vitta does not appear to be ever interrupted, nor is it ever well separated from the suture, and is most frequently entirely confluent with the suture. The prosternum seems to be always more or less piceous.

10. M. l i v e n s, testaceus, subtiliter longius pubescens, capite subinfuscato, thorace latitudine longiore, antice angustato et lateribus rotundato, sat dense minus subtiliter punctato, vitta dorsali antice abbreviata infuscata, sæpe obsoleta, elytris striis modice profundis punctatis, interstitiis subtilissime punctulatis, sutura, vitta dorsali antice paulo divergente fasciaque postica infuscatis. Long. ·29.

California, at Vallecitas and at the Colorado river. Differs from the preceding by the coarser punctuation of the thorax, and the uniform yellow colour of the under surface. In one specimen the fuscous markings of the upper surface are reduced to an angulated band near the tip of the elytra, and slightly dilated along the suture.

11. M. c i r c u m s c r i p t u s, nigro-piceus, subtiliter parce pubescens, thorace latitudine longiore, testaceo, vitta dorsali dilatata nigro-picea, confertim minus subtiliter punctato, elytris striis punctatis, sat profundis, interstitiis punctulatis, testaceis vitta integra nigro-picea postice cum sutura confluente; abdomine lateribus rufescente, antennis pedibusque flavis. Long. ·2—·3.

Elater circumscriptus Germ. Ins. Nov. 46.

? Cryptohypnus circumscriptus Germ. Zeitschr. 5, 146.

Middle and Southern States. I place a query before the last synonym, as nothing is

said in the description concerning the testaceous sutural margin of the elytra, and the dorsal vitta of the thorax is said to be abbreviated. Three specimens in my collection agree perfectly with the first description given by Germar: a fourth has a small fuscous fascia near the apex of the elytra, thus approaching Germar's second description: the vitta of the elytra might very easily be so dilated as to remove the sutural yellow margin entirely, and if this form coexisted with the posterior band just mentioned, the elytra would agree with those described in Germar's Zeitschrift: but I cannot suppose that the dorsal black vitta of the thorax would ever become abbreviated posteriorly as there described.

Apart from the coloration of the elytra, this species is distinguished from M. dorsalis by the longer and more densely punctured thorax: the thorax of the male is almost one-half longer than wide, and its sides are nearly straight: those of the female are broadly rounded anteriorly, and the disc is anteriorly a little more convex than in M. dorsalis. The under surface of the thorax and prosternum is more or less varied with blackish piceous.

12. M. d o r s a l i s, testaceus, subtiliter parce pubescens, capite nigro, thorace latitudine longiore, antice angustato et lateribus rotundato, minus dense punctato, linea dorsali fusiformi nigra, elytris striis profundis punctatis, interstitiis parce punctulatis, macula utrinque elliptica ante medium, fasciaque pone medium angulata nigris, postpectore abdomineque nigro-fuscis. Long. ·23—·27.

Elater dorsalis Say, Journ. Acad. Nat. Sc. 3, 167.

Cryptohypnus dorsalis Germ. Zeitschr. 147.

A very common species, sufficiently distinct from all its allies by the distinct, distant punctures of the thorax.

13. M. a m a b i l i s, testaceus, subtiliter parce pubescens, capite nigro, thorace latitudine longiore, antice angustato et lateribus rotundato, sat dense punctato, linea dorsali fusiformi nigra, elytris striis sat profundis punctatis, interstitiis parce punctulatis, sutura antice, macula utrinque elongata, fasciaque postica angulata nigris. Long. ·18.

Maryland, Prof. Adams. This beautiful little species is a miniature of M. dorsalis, and only differs by the thorax being more densely punctured, and a little more convex: the suture is blackish near the scutellum, and the spot shows a disposition to be prolonged to the posterior band, neither of which characters is seen in M. dorsalis. In two specimens the under surface is testaceous, in a third the postpectus and abdomen are dusky.

14. M. l e p i d u s, testaceus, subtiliter pubescens, capite nigro, thorace latitudine sesqui longiore, antice vix angustato, angulis posticis divaricatis, confertim minus subtiliter punctato, linea tenui dorsali fusca, elytris striis profundis punctatis, interstitiis parce punctulatis, sutura angustissime, vittaque angusta versus apicem cum sutura confluente fuscis, hac saepe obsoleta. Long. ·18.

Two specimens, Georgia. The colour beneath is uniform, pale, testaceous. This species is less shining than the others, and more elongate in its form: the long densely punctured thorax, not narrowed in front, hardly rounded on the sides, and slightly narrowed before the divergent posterior angles will readily distinguish it.

Hemirhipus *Latr.*

1. H. f a s c i c u l a r i s, niger, dense fusco-cinereo-pubescens, thorace latitudine longiore, antrorsum modice angustato, lateribus rufescentibus late rotundatis, sat grosse punctato, basi medio breviter ele-

vato, elytris striis punctatis, interstitiis punctulatis alternatim paulo elatioribus, lineis undatis apiceque fuscis. Long. ·75.

Germ. Zeitschr. 2, 272.

Elater fasciicularis Fabr. Syst. El. 2, 222: Oliv. Ent. 31, 8; tab. 5, fig. 56: Herbst, Käfer, 10, 104; tab. 168, fig. 1.

Baltimore, North Carolina, Texas, extending into Mexico, and, according to authors, found also in South America. From the extensive range through which it occurs in North America, it is scarcely to be supposed that this insect, though rare with us, has been introduced.

Cryptohypnus *Esch.* (*emend.*)

This genus is here restricted to such species as have the prosternum broader in the middle than at either end: the lateral suture is consequently convex outwards: the coxal plates are suddenly moderately dilated internally, but the tooth is not prominent: the tarsi are moderately short, and hispid with long bristles. Our species may form two groups.

A. *Prosternum lobo rotundato; palpi articulo ultimo triangulari.* Sp. 1—5.

1. C. silaceipes, olivaceo-niger, subtilius aureo-pubescens, fronte margine antico vix elevato, thorace antrorsum angustato, lateribus ante basin obtuse subangulatis, minus dense punctato, canaliculato, elytris striis obsolete punctatis, interstitiis antennisque basi plus minusve testaceis. Long. ·21—·27.

Germ. Zeitschr. 5, 139.

Common in the northern part of the United States. The golden hair is more dense each side at the apex of the elytra so as to show, in particular lights, the appearance of a faint spot. The elytra are sometimes dark testaceous: the punctures of the striæ are by no means obvious.

2. C. lacustris, subæneo-niger, nitidus, griseo-pubescens, fronte margine antico vix elevato, thorace antrorsum angustato, lateribus sat late rotundatis, parcius punctato, canaliculato, elytris striis impunctatis, interstitiis subconvexis, basi et apice indeterminate rufo-piceis, antennis basi pedibusque testaceis. Long. ·19.

One specimen, Point Kewenaw, Lake Superior. The posterior angles of the thorax and the inflexed portion are dark testaceous. This species resembles the last, but is smaller, and the sides of the thorax are regularly rounded. From the next species it is distinguished by the thorax being distinctly narrowed in front.

3. C. picescens, picco-testaceus, supra nigricans, griseo-pubescens, fronte margine antico vix elevato, thorace oblongo, antrorsum vix angustato, lateribus fere parallelis vix late rotundatis, parcius punctato, canaliculato, angulis posticis testaceis, elytris piceis margine dilutiore, striis impunctatis, interstitiis subconvexis, antennarum basi pedibusque testaceis. Long. ·20.

Three specimens from the north side of Lake Superior. This species is sufficiently distinct by the form of the thorax to be recognised without difficulty: as in the preceding species the fourth joint of the antennæ is a little narrower than the following.

4. C. tumescens, obesus, virescenti-ater, cinereo-pubescens, thorace convexo, antrorsum valde angustato, lateribus rotundatis, dense subtilius punctato, elytris striis vix obsolete punctatis, intersti-

tiis paulo convexis, pedibus flavo-testaceis, antennis piceis, articulis 2 et 3 æqualibus flavis, 4to sequenti æquali. Long. ·15.

One specimen, north shore of Lake Superior. The front is flat, with the anterior margin distinct: it is as finely punctured as the thorax. This species has very much the appearance of Cardiophorus, but the prosternal spine is long.

5. C. squalidus, depressus, fuscus, pube grisea subsquamosa minus dense vestitus, thorace dense grossius punctato, subaciculato, antrorsum subangustato, lateribus late rotundatis, elytris striis subtilibus, distinctis, punctatis, interstitiis planis confertim punctatis, antennis pedibusque flavis. Long. ·33.

One specimen, San Jose, California. The lobe of the prosternum is longer than in the preceding species and more rounded: the general appearance is that of Adelocera. The anterior margin of the front is slightly elevated: the fourth joint of the antennæ is equal to the fifth.

B. *Prosterno lobo subtruncato; palpi articulo ultimo obovali.* Sp. 6—12.

6. C. ornatus, niger, parce griseo-pubescens, thorace latitudine longiore, antice valde angustato, ad basin paulo angustato, grossius dense aciculato-scabro, carinato, elytris striis exaratis, interstitiis convexis, fascia utrinque pone basin, maculaque transversa pone medium margine non attingentibus læte flavis, tibiis tarsisque testaceis. Long. ·11—·16.

San Diego, California. June, abundant in wet sand. This species resembles the next, but the thorax is less elongate, and more suddenly narrowed in front: the scabrous punctuation is very much coarser: the anterior fascia of the elytra, although dilated externally, is never prolonged to the humerus: the femora appear to be always fuscous.

7. C. pulchellus, niger, opacus parcius pubescens, thorace latitudine sesqui longiore, antrorsum angustato, ad basin leviter angustato, lateribus latius rotundatis, subtilius confertissime aciculato, elytris striis exaratis, interstitiis convexis, fascia utrinque pone basin, extus ad humerum producta, maculaque transversa pone medium flavis, antennis basi femoribusque testaceis, tibiis tarsisque pallidioribus. Long. ·11—·17.

Dej. Cat.; Germ. Zeitschr. 5, 112.

Elater pulchellus Linnæus, Faun. Suec. 715, et auctorum omnium cautorum.

Elater exiguus Randall, Bost. Journ. Nat. Hist. 2, 35.

Cryptohypnus guttatulus Melsheimer, Proc. Acad. Nat. Sc. 2, 214.

Massachusetts and New York. It is quite possible that this species has been introduced from Europe: it does not seem to occur far in the interior of the country. The fascia of the elytra is composed of a small internal, and an elongate external spot, reaching from the humerus nearly to the middle. Sometimes the elytra are testaceous, with a faint cloudiness behind the middle. In this and the preceding species, the lobe of the prosternum is large, and separated from the sternum by a strong transverse carina.

8. C. guttatulus, ater, nitidus pubescens, thorace antrorsum valde angustato, punctulato, elytris distincte striatis, interstitiis subconvexis, impunctatis, macula humerali, alteraque utrinque ante apicem antennis pedibusque testaceis. Long. ·12.

Melsheimer, Proc. Acad. Nat. Sc. 2, 214.

I have seen only a badly preserved Pennsylvanian specimen, in Dr. Melsheimer's collec-

tion. The lobe of the prosternum is short, and hardly deflexed, and not well defined from the rest of the sternum. This species seems to have been confounded by Dr. Melsheimer with the preceding: in fact his description agrees entirely with the preceding, except in the description of the spots of the elytra. I have, however, retained Dr. Melsheimer's name, as this specimen was placed as the type in his collection. It is quite possibly identical with C. 4-pustulatus, a European species, and may have become erroneously labelled as American. The state of the specimen, however, is very unsatisfactory.

9. C. striatulus, ater, minus convexus opacus, tenuiter cinereo-pubescens, thorace latitudine non longiore, antrorsum angustato, lateribus regulariter sat rotundatis, confertissime punctulato, linea dorsali lævi, elytris distincte striatis, interstitiis planiusculis dense rugose punctulatis, antennis pedibusque piceis, tibiis tarsisque subtestaceis. Long. ·14.

Two specimens, Lake Superior. The lobe of the prosternum is short, broad, and well defined by a deep transverse impression: the last joint of the palpi is rounded at the extremity as in C. pulchellus.

10. C. pectoralis, piceus flavo-pubescens, thorace rufescente minus convexo, antice posticeque angustato, lateribus rotundato, punctulato, linea dorsali lævi, elytris vix obsoletissime striatis, confertim punctulatis, plaga utrinque a medio fere ad basin extensa, alteraque apicali flavo-testaceis, antennis pedibusque flavis. Long. ·12.

Elater pectoralis Say, Trans. Am. Phil. Soc. 6, 173.

Middle States and Lake Superior, not rare. The lobe of the sternum is short, broad, and tolerably deflexed: the posterior angles of the thorax as in the following species are small, but the carina is distinct. Independently of colour, this species differs from the following by the thorax being much less convex, and by the traces of striæ visible on the elytra. When the spots of the elytra are large, the latter appear yellow, with the margin, suture and posterior fascia, blackish. Specimens occur in which the thorax is black, and the spots of the elytra obsolete.

11. C. obliquatulus, nigro-piceus, punctulatis, cinereo-pubescens, thorace convexo, antice posticeque angustato, lateribus magis rotundatis, elytris versus apicem testaceis, macula utrinque obliqua ad medium alba signatis, antennis pedibusque flavis. Long. ·10—·11.

Melsheimer, Proc. Acad. Nat. Sc. 2, 214.

Pennsylvania. Messrs. Melsheimer and Zeigler.

12. C. futilis, longiusculus pallide flavo-testaceus, albo-pubescens, capite piceo, thorace quadrato, antice posticeque vix angustato, lateribus late rotundatis, confertim rugose punctulato, linea dorsali lævi, elytris punctulatis, macula subscutellari, fasciaque pone medium infuscatis. Long. ·08.

San Diego, California, in wet sand. This is the smallest species I have seen. The thorax is broadly rounded on the sides, and not very convex: the posterior angles are very minute, but the carina is distinct: the lobe of the prosternum is short, and defined by a transverse impression.

13. C. inops, piceus, cinereo-pubescens, thorace latitudine paulo breviore, convexo, antice posticeque subangustato, lateribus rotundatis, rugose punctulato, linea tenui dorsali lævi, macula magna dorsali testacea, elytris punctulatis, testaceis macula magna communi scutellari, fascia pone medium, suturaque late nigro-piceis, antennis pedibusque flavis. Long. ·08—·09.

San Diego, California. This species in characters closely resembles C. futilis: besides the differences in colour, it is a little more robust; the carina of the posterior angles of the thorax is much more distinct, being one-third the length of the thorax, and is almost parallel with the margin.

To this genus belongs Elater c h o r i s *Say*, (Trans. Am. Phil. Soc. 6, 172:) it is apparently allied to C. pulchellus, but is larger, has the thorax covered with golden hair, and the elytra yellow with black bands.

E. n o c t u r n u s *Esch.* Thon. Arch. 2, 33: Mann. Bull. Mosc. 1843, 239; C. m u s c u l u s *Esch.* ib.: Mann. ib.; and C. l i t t o r a l i s *Esch.* ib.: Mann. Bull. Mosc. 1846; all from North-Western America, are unknown to me.

C. c i n e r e i p e n n i s *Esch.* and C. p u b e r u l u s *Mann.* l. c. 240, do not belong to this genus, the tarsi being furnished with a lobe beneath.

Elater d o r s a l i s *Say*, and E. c i r c u m s c r i p t u s *Germ.*, referred by Germar (Zeitschr. 5, 146) to his second division of this genus, differ by their narrower prosternum, subacuminate mesosternum, and tarsi destitute of elongate setæ: the more convex and deflexed head gives them more resemblance to Elater, in general appearance, but from the elongate basal joint of the antennæ and other characters, I have placed them in Monocrepidius.

Oedostethus *Lec.*

Frons plana semicircularis, marginata, tenuiter canaliculata: labrum antice rotundatum: mandibulæ prominulæ parvæ obtusæ; antennæ longiusculæ, vix serratæ, articulo 1mo obconico mediocri, 3to sequenti non breviore 2^ndo^ sesqui longiore; 11mo acuto, non constricto: prosternum antice brevissime lobatum, mucrone postico non inflexo, medio latius, sutura inde convexa, antice paulo exarata; mesosternum non protuberans: coxæ posticæ laminis subsubito parum dilatatis, vix dentatis: tarsi elongati, pubescentes, tenuissimi, articulis 1–4 sensim brevioribus, 5to 1mo longiore, unguiculis medio dente forti armatis.

A curious little subcylindrical elongated insect, having somewhat the appearance of a slender Cardiophorus, or some of the last described species of Cryptohypnus, with the thorax distinctly margined, and as much narrowed in front of the spines as at the apex; the sides are considerably rounded, and the disc convex; the posterior angles are small, acute, diverging and carinated; there are no basal fissures: the mandibles are more prominent than usual, but are not long and slender as in the Cebrionides.

1. O. f e m o r a l i s, nigro-piceus, tenuiter cinereo pubescens, thorace convexo, rotundato, latitudine longiore, subtiliter punctulato, angulis posticis parvis divergentibus, elytris confertim punctulatis, striis obsoletis, basi et versus suturam parum distinctis, antennarum articulis duobus, pedibusque flavis, his femoribus infuscatis. Long. ·18.

One specimen found in Missouri Territory, another from New Jersey, given me by Mr. Guex. The striæ of the elytra are very fine and impunctured; except at the base, and towards the suture, they can scarcely be seen. The head is punctulate like the thorax; the margin is very slightly reflexed, and the impressed frontal line is not abbreviated, although not deep.

Adelocera *Latr.*

1. *Antennæ articulo 3^io^ secundo longiore.*

a. Sulci antennarum integri.

1. A. impressicollis, fusco-brunnea, opaca, pilis depressis luteis minus dense vestita, thorace oblongo, obsolete canaliculato, disco postice utrinque subfoveato, sat dense punctato, angulis posticis planis subdivergentibus, elytris dense subseriatim punctatis, sulcis tarsalibus obsoletis. Long. ·36—·47.

Elater impressicollis Say, Ann. Lyc. 1, 260; Tr. Am. Phil. Soc. 6, 182.

Elater lepturus||Say, Trans. Am. Phil. Soc. 6, 182 (var. obscurior.)

Adelocera senilis Germ. Zeitschrift für Entom. 2, 259.

Middle, Western, and Southern States. Between the descriptions given by Say, I can find no characters for considering his *El. lepturus* as distinct: the name itself was preoccupied by Herbst. The antennæ of this species are longer than in the next, and the joints are hardly transverse.

2. A. pennata, nigra, opaca, thorace oblongo, canaliculato, postice utrinque foveato, punctato, lateribus late, capiteque fulvo-squamosis, squamis angustis, elytris confertim punctatis, sulcis tarsorum plus minusve distinctis. Long. ·33—·43.

Germar, Zeitschr. 2, 258.

Elater pennatus Fabr. Syst. El. 2, 239; Herbst, Käfer, 10, 52, tab. 162, fig. 9.

Elater discoideus Weber, Obs. Ent. 77; Say, Trans. Am. Phil. Soc. 6, 181.

Elater cruentus Oliv. Ent. 31, tab. 4, fig. 42.

Middle and Southern States, not rare. The date of Weber's name is equal to that of Fabricius', but the latter is generally adopted.

3. A. aurorata, nigra, opaca, squamis subaureis conspersa, thorace oblongo, confertim punctato, profunde canaliculato, angulis posticis planis divergentibus, elytris confertim punctatis, parcius squamosis, subtus cinereo-pubescens, tarsis rufis, sulcis tarsorum modice profundis. Long. ·54.

Elater auroratus Say, Trans. Am. Phil. Soc. 6, 181.

The typical specimen from New Hampshire was kindly loaned me by Dr. Harris. This species resembles, in form and general characters, the next, but is abundantly distinct.

4. A. marmorata, nigra, subopaca, squamis luteis angustis irregulariter maculata, thorace oblongo, profunde canaliculato, confertim punctato, angulis posticis planis subdivergentibus, elytris dense subseriatim punctatis, sulcis tarsorum anticorum profundis. Long. ·6—·7.

Germ. Zeitschr. 2, 258.

Elater marmoratus Fabr. Syst. El. 2, 227; Herbst, Käfer, 10, 124; Say, Tr. Am. Phil. Soc. 6, 180.

Southern States, not rare.

b. Sulci antennarum postice abbreviati.

5. A. obtecta, nigra, squamis pallidis ellipticis irregulariter vestita, thorace oblongo, punctato, fortiter canaliculato, versus latera depresso, angulis posticis valde divergentibus, elytris disperse punctatis, vix obsoletissime striatis, costa utrinque obsoleta usque ad medium extensa: sulcis tarsorum nullis. Long. ·6.

Elater obtectus Say, Trans. Am. Phil. Soc. 6, 181.

Maine and Vermont. The antennæ are moderately long, the second joint is much smaller than the third, and the following are transverse, as is usual in this genus. The pectoral grooves end suddenly near the anterior coxæ.

6. A. brevicornis, nigra, opaca, squamis fulvis vel pallidis et nigris ellipticis irregulariter variegata, dense punctata, thorace breviusculo, inæquali, postice angustiore, late profunde canaliculato, antice valde bifoveato, angulis posticis compressis, elevatis, apice inflexis, elytris fascia postica obliqua interrupta densius squamosa; antennis thorace triplo brevioribus. Long. ·55—·70.

Lake Superior. This species seems to be very similar to A. conspersa *Germ.*, but the posterior angles of the thorax are not carinated, though compressed and elevated by the excavation of the basal part of the thorax each side. The antennæ are remarkably short, the joints are strongly transverse, and the second joint, though narrower, is not shorter than the others.

2. *Antennæ articulo 3to secundo æquali.*

7. A. mucorea, nigra, dense sordide pubescens, fusco-variegata, thorace subcanaliculato sat dense punctato, antrorsum angustato, basi truncato, angulis posticis divergentibus, elytris striis punctatis vix impressis, interstitiis subtilius confluenter punctatis, antennis rufo-piceis. Long. ·55.

One specimen, Georgia. Similar in form to the following species, but very different in characters.

8. A. curtus, nigro-picea, parce subtiliter squamosa, thorace cribratim punctato antrorsum angustato, lateribus rotundatis antice crenatis, angulis posticis rectis, elytris punctis transversis seriatim positis, interstitiis striis non latioribus, parce obsolete punctulatis, antennis pedibusque rufo-testaceis. Long. ·43.

Georgia. This species is *Agrypnus curtus* of Dejean's catalogue, and resembles very closely the next, but is distinguished by the greater size of the punctures which compose the striæ of the elytra: the body is very coarsely punctured beneath, and, as in the next species, is thinly clothed with depressed small scale-like yellow hairs.

9. A. rectangularis, picea, parce subtiliter luteo-squamosa, thorace cribratim punctato, antrorsum angustato, lateribus rotundatis, antice crenatis, angulis posticis rectis, elytris punctato-striatis, interstitiis striis latioribus, parce obsolete punctulatis, antennis pedibusque testaceis. Long. ·33—·38.

Elater rectangularis Say, Ann. Lyc. 1, 263; Trans. Am. Phil. Soc. 6, 182.

Missouri Territory, abundant. The pectoral grooves for the anterior tarsi are almost obsolete: in the preceding they are more distinct, while in A. mucorea, they are altogether wanting: the elytra of the female are slightly dilated behind the base, and are more obtusely rounded towards the tip than in the male.

To this genus, and to the first division, probably belongs the Elater operculatus mentioned by Say, as described in the Annals of the Lyceum: but as he has evidently misquoted himself, and no description bearing that name is found in his writings, it must be considered as unpublished: Elater avitus *Say* (Trans. Am. Phil. Soc. 6, 182) seems allied to A. impressicollis.

AGRYPNUS *Esch.*

1. A. Sallei, picco-niger, subtiliter brunneo-pubescens, thorace latitudine longiore, antrorsum paulo angustato parum convexo, confertim punctato, lateribus antice paulo rotundatis, postice extrorsum curvatis, angulis posticis inde divaricatis, carina angulari subtili elongata margini parallela, linea

dorsali obsoleta lævi, basi ad medium acute tuberculata, elytris postice acutis, dense punctulatis, striis tenuibus punctulatis. Long. ·85—1·10.

This species was discovered by Mr. A. Sallé near New Orleans, and kindly given me by Mr. Guex. It agrees so closely with the descriptions and figures of A. fuscipes *Fabr.*, that I supposed it to be that species, imported accidentally from the East Indies. Recently, however, Mr. Schott, of the Mexican Boundary Commission, has found it in abundance on the lower Rio Grande, at Eagle Pass. Between the punctures of the elytra may be perceived small transverse rugosities: the smooth dorsal line of the thorax is very indistinct, and is visible only near the base; the basal tubercle is large and almost reclivate.

2. A. S c h o t t i i, piceo-niger, subtiliter brunneo-pubescens, thorace latitudine vix breviore antrorsum angustato, convexo, lateribus rotundatis, angulis posticis subdivergentibus, carina elongata subtili margini parallela, confertim punctato, linea dorsali indistincta lævi, basi ad medium tuberculata, elytris postice acutis, dense punctulatis, striis subtiliter punctatis. Long. 1·07.

I have named this fine species after Mr. Schott, as a slight tribute to the scientific zeal displayed while attached to the Boundary Commission under Majors Graham and Emory; a single specimen was procured on the lower Rio Grande. The sculpture is as in the preceding, from which this species differs in the form of the thorax. It exactly resembles in appearance the Egyptian A. notodonta *Latr.*

Pyrophorus *Illiger.*

1. P. p h y s o d e r u s, piceo-fuscus, pubescens, thorace latitudine longiore antrorsum modice angustato, lateribus late rotundatis, confertim punctato, antice convexo, vesiculis mox ante angulis posticis positis, elytris dense punctulatis, striis punctatis, apice non mucronata, antennis thorace vix longioribus articulo 3^io^ secundo sesqui maiore. Long. ·75.

Germ. Zeitschr. 3, 36.

For a specimen found in Louisiana, I am indebted to Mr. Guex. The little tubercle of the middle of the base of the thorax is quite prominent.

Aphanobius *Esch.* (*emend.*)

This genus should be restricted to those species having the last joint of the antennæ deeply constricted, the front slightly concave and not margined in front; the mesosternum prominent; the plates of the posterior coxæ somewhat suddenly slightly dilated, and emarginate posteriorly, and the internal tooth sharp, and moderately large: the tarsi are somewhat inflated beneath, and very densely pubescent, (being in this respect precisely as in Agrypnus fuscipes.) The first joint of the antennæ is moderately elongated, the second and third small, the fourth and following strongly triangular, and equal: the suture of the prosternum is bent outwards posteriorly, and is very deeply marked: the first joint of the tarsi is hardly as long as the second and third united: the base of the thorax has a slight elevation in front of the scutellum, but it is by no means obvious: the posterior angles have a short carina: there are no apparent basal fissures.

1. A. i n f u s c a t u s, niger, dense breviter fusco-pubescens, thorace convexo latitudine longiore,

lateribus parallelis apice rotundatis, sat dense punctato, elytris a basi angustatis, apice mucronatis, sat dense punctatis, vix obsoletissime striatis. Long. 1·10.

Germ. Zeitschr. 5, 183.

Pristilophus? sordidus Mels. Proc. Acad. Nat. Sc. 2, 216.

Southern States, not common. It is strange that Germar should not have recognised the relation with certain species placed by him in Pristilophus. The resemblance in the form of the thorax gives the insect somewhat the appearance of a gigantic Dolopius.

Melanactes *Lec.*

Frons depressa, antice rotundata, vix marginata; antennæ serratæ, articulo 2do parvo, 3^io^ sequente paulo longiore non dilatato, 11mo non maiore apice constricto: labrum antice rotundatum: mandibulæ breves, apice acutæ, pone apicem unidentatæ; palpi articulo ultimo non longiore triangulari: prosternum elongatum, antice longius lobatum, postice fortius mucronatum, mucrone compresso non inflexo, lateribus rectis, sutura antice paulo excavata: mesosternum utrinque prominulum: coxæ posticæ laminis angustis intus sensim paulo dilatatis: tarsi mediocres, tenues, compressi, pubescentes, subtus densissime breviter spongioso-pubescentes; articulis 1—4 sensim brevioribus, 5to longiore unguiculis simplicibus.

These are large, shining, black insects, forming the first division of the genus Pristilophus, as defined by Germar, (Zeitschr. 4, 82.) Notwithstanding the care taken by the author, the description of the genus fails entirely when applied to the species here alluded to, since they belong to a totally different group of Elaters, from that in which Pristilophus was placed: the tarsi, indeed, so far from being uniformly pubescent above and below, as in Corymbites, are thinly pubescent above, and furnished with a very dense brush beneath, as in Alaus: the peculiarity in the form of the mesosternum was pointed out by Germar, and was, in fact, the character upon which he arranged his species in two divisions. The thorax in all the species is strongly margined: the base is without any fissure and is bidentate in the middle: the posterior angles are carinated.

As the characters of this genus are completely at variance with those laid down for Pristilophus both by Latreille and Germar, it would obviously be absurd to retain the name for the species here included, even if, after examination, we have found it necessary to place the remainder of Germar's Pristilophus in Corymbites.

1. M. procerus, niger nitidus, thorace subtransverso, ad medium latiore, lateribus valde rotundatis, angulis posticis divergentibus, subtilius punctato, densius ad latera, elytris subtiliter seriatim punctatis, interstitiis subtilissime parce punctulatis. Long. 1·3.

One specimen, from Mr. Hentz' collection; Prof. Haldeman. This species resembles in characters M. piceus, but the difference in the form of the thorax is very great. The thorax is a little wider than long, very slightly convex, considerably rounded on the sides, so as to be wider at the middle than immediately at the base of the spines, which thus appear to diverge more strongly than in the other species: the punctures are, as in M. piceus, small, and more dense on the sides than on the middle of the disc: there is an impressed dorsal line behind the middle. The elytra are slightly compressed on the sides behind the base: they are punctured as in M. piceus, and as in that species, the outer striæ of punctures are more distinct. Beneath, the prosternum and inflexed part of the prothorax are coarsely punctured: the metasternum is nearly smooth in the middle, sparsely and finely

punctured at the sides: the abdomen is densely and finely punctured, the last joint has a few larger setigerous punctures each side near the tip.

2. M. piceus, niger nitidissimus, thorace a basi antrorsum subangustato, latitudine longiore, lateribus antice rotundatis, subtilius punctato, densius ad latera, elytris subtiliter seriatim punctatis, interstitiis subtilissime parce punctulatis. Long. ·9—1·2.

Elater piceus De Geer, Ins. 4, 162, tab. 18, fig. 3, (1775.)

Elater lævigatus Fabr. Ent. Syst. emend. Suppl. 138, (1798:) Syst. El. 2, 225: Herbst, Käfer, 10, 45.

Elater morio (var.) Say, Trans. Am. Phil. Soc. 6, 165.

Pristilophus lævigatus Germ. Zeitschr. 4, 84.

Pristilophus femoralis Melsheimer, Proc. Acad. Nat. Sc. 2, 216.

Middle, Southern and Western States, abundant. The antennæ and feet are described as fuscous by all the authors: the latter appear to me to be black, with the tarsi brownish piceous: the antennæ are dull black, becoming brownish towards the tip. These are, however, characters of no importance, as they are the same in all the species.

A specimen from Missouri Territory has the punctures of the thorax and of the elytral series much larger, but otherwise presents no difference.

One specimen from York Co., Pennsylvania, given me by the Rev. D. Ziegler, in form and sculpture agrees exactly with the others, except that the thorax, instead of being sparsely, is quite densely punctured: the punctures at the sides are so close as to become confluent; towards the middle of the base they are finer and more distant: the dorsal line is more deeply impressed than usual. From the next species, this variety is distinguished by the sides of the thorax converging from the base, and by the posterior angles being subacute, as in the preceding species, the lateral margin being slightly dilated, so as to compress the elevated ridge.

3. M. densus, ater, nitidus, thorace latitudine non longiore, lateribus parallelis antice rotundatis, confertim, lateribus confluenter punctatis, elytris seriatim punctatis, interstitiis punctulatis et rugosis. Long. ·85—·95.

Specimens collected in California by Mr. Pease and Mr. Child. Brownish black, shining: head densely punctured; antennæ with the last joint more obtuse than in the other species: palpi black: thorax not longer than wide; sides margined as usual, parallel, rounded from the anterior third to the tip: posterior angles not divergent, with the elevated ridge broader and more obtuse than in M. piceus; disc densely moderately finely punctured; punctures confluent at the sides, less dense but not finer towards the middle of the base; dorsal line very short, almost obsolete: elytra, with series of punctures, as in M. piceus, the outer series being more distinct; interstices tolerably densely punctate, and more densely finely rugous than in the preceding species. Beneath, as in M. piceus.

4. M. morio, niger, nitidus, thorace latitudine longiore, a basi subangustato, lateribus antice rotundatis, lateribus confertim medio minus dense punctato, elytris striis profundis crenatis, interstitiis convexis parce punctulatis, subrugosis. Long. ·90—1·06.

Elater morio Fabr. Ent. Syst. emend. Suppl. 138: Syst. El. 2, 225: Herbst, Käfer, 10, 28; tab. 160, fig. 7: Say, Trans. Am. Phil. Soc. 6, 165.

Elater lacunosus Fabr. Syst. El. 2, 224.

Pristilophus morio Germ. Zeitschr. 4, 85.

Middle and Southern States, rare. E. lacunosus, as observed by Germar is undoubtedly a variety, having abnormal impressions on the thorax.

5. M. puncticollis, niger, nitidus, thorace latitudine longiore, a basi antrorsum subangustato, lateribus antice rotundatis, confertim, disco minus dense punctato, elytris striis fortius punctatis, interstitiis leviter convexis, distinctius punctulatis. Long. ·75—·9.

Pristilophus puncticollis Lec. Proc. Acad. Nat. Sc. 6, 68.

Missouri Territory, abundant. This species agrees in characters with the preceding, but is usually smaller, with less deep elytral striæ, and less convex interstices.

6. M. consors, latiusculus, niger, thorace latitudine non longiore, lateribus rotundatis, ad medium sublatiore, confertim punctato, paulo remotius in disco, elytris striis punctatis, interstitiis leviter convexis, punctulatis et rugosis. Long. ·88.

One specimen, Nebraska. Differs from the preceding by its less shining colour, broader form, and more densely punctured thorax. Body black, not very shining; head densely punctured; antennæ reaching a little beyond the middle of the thorax; thorax not longer than wide, at the middle as wide as at the posterior angles, which from the slight narrowing of the base appear divergent; sides broadly rounded, strongly margined: disc densely punctured, punctures a little more distant at the middle, dorsal line not distinct, somewhat smooth. Elytra scarcely perceptibly narrower than the thorax, more obtusely rounded posteriorly than in the two preceding species; striæ well defined, strongly punctured; interstices slightly convex, finely punctulate and rugous.

7. M. Reichei, niger nitidus, pube brevissima grisea depressa vix conspicua vestitus, thorace latitudine longiore, medio vix latiore, lateribus rotundatis, confertim, lateribus confluenter subtilius punctato, postice canaliculato, elytriis striis fortius punctatis, interstitiis parum convexis, rugosis. Long. ·90.

Pristilophus Reichei Germ. Zeitschr. 4, 85.

One specimen, Georgia. Easily distinguished by the fine short gray hairs which proceed from the punctures: the thorax is more convex than in any of the other species. Germar describes the interstices of the elytra as flat, but in my specimen they are slightly convex, as in the two preceding species.

Chalcolepidius *Esch.*

1. C. viridipilis, elongatus, niger, pilis minutis squamiformibus olivaceis dense tectus, thorace elongato, subtilissime punctulato, angulis posticis vix divergentibus, scutello obovato, antice obtuso, elytris striis profundis punctatis, interstitiis parce punctulatis, antennarum articulo 3° parvo, apice acuto. Long. ·90.

Elater viridipilis Say, Ann. Lyc. 1, 257; Trans. Am. Phil. Soc. 6, 166.

Middle and Southern States, rare. The antennæ of the male are pectinate, those of the female are strongly serrate. This species must resemble very closely the Brazilian C. prasinus *Erichson* (Germ. Zeitschr. 3, 85;) but that species is described as having the thorax finely, tolerably densely punctured, and the scutellum bicuspid anteriorly. Should they prove identical, Say's name has priority.

Alaus *Esch.*

1. A. oculatus, niger, nitidus, pilis albidis irregulariter maculatus, thorace convexiusculo, disco utrinque macula magna elliptica nigro-sericea albo-marginata ornato. Long. 1·25—1·7.

Eschscholtz, Thon Ent. Archiv., 1829; Germ. Zeitschr. 2, 275.

Elater oculatus Linné, Mus. Ubr. 81; Syst. Nat. 2, 651: Fabr. Ent. Syst. 210; Ent. Syst. emend. 2, 217; Syst. El. 2, 222: Oliv. 31, 11; tab. 3, fig. 34: Herbst, Käfer, 9, 327; tab. 157, fig. 7: Beauv. 213; tab. 9, fig. 4.

Common through the Atlantic portions of the United States, extending into Mexico. A variety brought from Texas, by Lieut. Haldeman, has the sides of the thorax entirely covered with the white scales, which usually form only small spots: the eye-like spots are nearly round, and the white scales upon the elytra are more abundant. The thorax of the females is more decidedly narrowed in front, and more convex than that of the males.

2. A. myops, niger, nitidus, pilis cinereis irregulariter conspersus, thorace minus convexo, antice sublatiore, disco utrinque macula angusta elliptica nigro-sericea, cinereo-marginata ornato. Long. ·95—1·8.

Eschscholtz, Thon Ent. Archiv. 1829; Germ. Zeitschr. 2, 275.

Elater myops Fabr. Syst. El. 2, 222.

Elater luscus‡ Oliv. 31, 12; tab. 6, fig. 64: Herbst, Käfer, 9, 329; tab. 157, fig. 8: Beauv. 213; tab. 9, fig. 5.

Middle States, rare; Southern States, abundant: found also in Oregon by Capt. Wilkes' Exploring Expedition. The confusion in the name of the species seems to have been introduced by Olivier applying to it a name given by Fabricius to a distinct species, not known in modern collections: the immaculate body, free from cinereous pubescence, and the absence of any margin to the eye-like spots of the thorax, will fully distinguish E. luscus, whenever it is found. Fabricius, with a carelessness which is but too frequent in his writings, then quotes Olivier's figure as belonging to his E. luscus, while on the preceding page he has already described the insect figured by Olivier, under the name of E. myops, and which is that by which the species is generally known. Beauvois and Herbst merely copy Olivier's error, considering it as sufficiently endorsed by Fabricius.

De Geer (Mem. 4, 159, tab. 17, fig. 28) describes a species under an uncouth Gallic name, which it is not necessary to repeat, and cites E. oculatus *Linn.* as a synonym: his figure, however, appears to represent the species now under consideration.

As there is no evidence that Elater luscus *Fabr.* is found within the limits of the United States, it is not safe to include it in our fauna.

Cardiophorus *Esch.*

The truncate spine of the prosternum, fitting like a wedge into the prominent and deeply cleft mesosternum, will distinguish this group, which contains only one genus: the front is subangulated and margined, moderately convex, slightly impressed: the laminæ of the posterior coxæ are suddenly dilated internally. The tarsi are not lobed in any species known to me, found in the United States.

A. *Tarsi et ungues simplices.* Sp. 1—11.

1. C. erythropus, elongatus, fusco-niger, cinereo-pubescens, thorace aequaliter fusco-cinereo pubescente, latitudine longiore, convexo, antrorsum angustato, postice breviter canaliculato, lateribus late rotundatis subtilissime punctulato, elytris striis subtilibus, fortius punctatis, interstitiis paulo convexis, pedibus antennarumque basi rufis. Long. ·37—·4.

Variat, antennis totis rufis.

Erichson, Germ. Zeitschr. 2, 293.

C. amictus Melsheimer, Proc. Acad. Nat. Sc. 2, 158.

? Elater convexus Say, Journ. Acad. Nat. Sc. 3, 169.

Middle and Southern States, not common. Distinguished from the next by the pubescence of the thorax being equal over its whole surface, and by the more distinct fine punctures with which it is covered; the posterior angles are more divergent in some specimens than in others. The elytra, as in the next, are somewhat pointed behind, with the interstices almost imperceptibly punctured. In the females the thorax is more parallel on the sides, and more suddenly rounded anteriorly.

2. C. saturninus, elongatus fusco-niger, cinereo-pubescens, thorace antice distinctius postice tenuissime cinereo-pubescente, antrorsum angustato, latitudine fere longiore lateribus rotundatis, confertissime subtilissime alutaceo-punctulato, postice breviter canaliculato, elytris striis subtilibus fortius punctatis, interstitiis paulo convexis, antennarum basi pedibusque rufis. Long. ·35.

One specimen, South Carolina, Mr. Zimmerman. Except the differences above pointed out, this species has all the characters of the preceding. The punctures of the thorax are so fine and close, that the lustre is dull and bluish on that portion of the body.

3. C. cardisce, niger, subopacus, tenuiter pallide pubescens, thorace latitudine fere longiore, tumido, antrorsum angustato, lateribus rotundatis postice inflexis, confertim punctulato, striis basalibus elongatis, exaratis, elytris ochreo bi- vel quadri-maculatis, postice acutis, striis profundis punctatis, interstitiis convexis dense punctulatis. Long. ·28.

Elater cardisce Say, Trans. Am. Phil. Soc. 6, 169; Journ. Acad. Nat. Sc. 3, 169.

Middle States, on the sea shore. The anterior spots of the elytra are about the middle, the posterior about one-fourth from the apex; the latter form an angulated fascia. Sometimes the anterior spots are wanting, and sometimes the posterior: varieties probably occur with immaculate elytra.

4. C. Dejeanii, plumbeo-niger, dense cinereo-fusco-pubescens, thorace latitudine subelongiore convexo, dense punctulato, lateribus late rotundatis, elytris striis postice exaratis, interstitiis convexis, dense punctulatis, postice acutis, maculis duabus obsolete testaceis, pedibus piceis, tibiis tarsisque testaceis. Long. ·25.

C. convexus Erichson: Germ. Zeitschr. 2, 289.

One specimen, Georgia. Erichson, probably misled by Dejean's collection, has confounded this with Elater convexus Say, Journ. Acad. Nat. Sc. 3, 169: a very different species which, by description, (having rufous antennae,) is nearly allied to C. erythropus. This species differs from the preceding by the thorax being longer, less rounded on the sides, and more densely pubescent.

5. C. tumidicollis, nigerrimus obesus, tenuissime cinereo-pubescens, thorace transverso, tumido, antrorsum angustato, lateribus valde rotundatis, angulis posticis non divergentibus, subtilissime punctulato, obsolete canaliculato, elytris striis punctatis, postice non exaratis. Long. ·25.

One specimen, collected in Oregon by Dr. J. K. Townsend, and given me by Mr. Wilcox. Resembles the next, but is a much thicker species, with a more tumid thorax. Colour deep black, sprinkled with very fine whitish hairs: front very finely punctulate; margin slightly reflexed: thorax at its greatest breadth nearly one-half wider than long, strongly narrowed in front, and very much rounded on the sides, gradually narrowed for the posterior third, with the sides straight near the base: disc convex, very finely, almost imperceptibly punctulate, obsoletely channelled: basal striæ moderately short, deep: elytra about twice as long as wide, not wider than the widest part of the thorax, oval, slightly pointed behind: striæ finely punctured, not deeper posteriorly: interstices flat, scarcely perceptibly punctulate: feet black; claws diaphanous.

This species is perhaps related to C. latiusculus *Esch.* (Thon Ent. Arch. 2, 34,) but the pubescence of the thorax is not fuscous, nor are the knees ferruginous, as is required by the description of that species.

6. C. convexulus, niger, nitidus, tenuiter cinereo-pubescens, thorace latitudine breviore, tumido, antice valde angustato, postice parum angustato, lateribus rotundatis, angulis posticis non divergentibus, subtilissime punctulato, elytris striis punctatis, interstitiis dense punctulatis, subconvexis 6to et 8vo paulo elevatis, tibiis versus apicem, tarsisque rufescentibus. Long. ·35.

Maine and Ohio, sent by Dr. Harris under the name adopted. Similar to the next species, but larger and more robust, with a much shorter thorax. The thorax is considerably less narrowed at the base than at the apex: the dorsal channel is very faint and short: the basal lines are short and well defined: the antennæ are entirely black, and a little longer than the head and thorax: the clypeus is more deeply concave than in C. gagates.

7. C. gagates, nigerrimus, tenuiter cinereo-pubescens, thorace latitudine sublongiore, tumido, lateribus rotundatis, angulis posticis divergentibus, dense subtiliter punctulato, basi breviter canaliculato, elytris striis punctatis, interstitiis paulo convexis, dense subtiliter punctulatis. Long. ·24—·28. Erich. Germ. Zeitschr. 2, 297.

Southern States, not rare. A specimen in Dr. Harris' collection is named C. convexus *Say*, but as the antennæ are black, it can by no means be referred to that species.

8. C. tenebrosus, plumbeo-niger, nitidus longiusculus, fusco subtiliter pubescens, thorace latitudine sublongiore, convexo, lateribus rotundatis, dense subtiliter punctulato, obsolete canaliculato, angulis posticis subdivergentibus, elytris dense punctulatis, striis punctatis, interstitiis leviter convexis, genubus femorumque basi rufo-piceis. Long. ·28—·32.

San Francisco, California. Nearly of the same form as the preceding, but with a less tumid thorax: the basal striæ of the thorax are a little longer: the rufous colour of the knees and trochanters is sometimes hardly perceptible.

9. C. obscurus, plumbeo-niger, opacus, dense fusco-pubescens, thorace latitudine non longiore, lateribus valde rotundato, convexo, confertissime subtilius punctato, postice subcanaliculato, angulis posticis divergentibus, elytris dorso subdepressis, striis punctatis, postice minus distinctis, interstitiis planis, dense punctulatis. Long. ·25.

San Diego, California. Resembles the next species, but the feet are entirely black, and the thorax is less lustrous: the basal striæ of the thorax are very short, and the base is deeply and decidedly transversely impressed between them.

10. C. lævicollis, plumbeo-niger, subnitidus, dense fusco-pubescens, thorace latitudine non breviore, convexo, lateribus rotundatis, dense subtiliter punctulato, postice canaliculato, angulis posticis divergentibus, elytris dorso subdepressis, striis punctatis, interstitiis punctulatis, vix convexis, pedibus rufis, femoribus sæpe nigricantibus. Long. ·28.

? Er. Germ. Zeitschr. 2, 300.

One specimen from New York, in which the anterior thighs alone are darker: another in the collection of Dr. Harris, having both thighs and tibiæ piceous. The palpi are black, and the posterior channel of the thorax is deep: these cannot, however, be constant characters. The basal striæ of the thorax are short, as in the preceding species. From the next species it differs by its less robust form, longer and less inflated thorax, and more distinct basal striæ. Erichson does not mention the slight flattening of the disc of the elytra.

11. C. robustus, plumbeo-niger, vel æneo-niger, minus elongatus, densius cinereo-pubescens, thorace latitudine breviore, convexo, subcanaliculato, lateribus rotundatis, dense subtiliter punctulato, angulis posticis vix divergentibus, elytris dorso subdepressis, striis punctatis, interstitiis planis, dense punctulatis, pedibus rufis, femoribus præcipue infuscatis. Long. ·36.

Middle States. If it were not for the superior size, this might be considered as C. lævicollis, but the thorax is fully one-third wider than long, and more convex than in the preceding; the feet vary very much in colour; the antennæ are always entirely black; the palpi are sometimes black and sometimes brown. The only difference between this and the last is in size and form, and future researches may show that these variations are sexual in their character.

B. *Ungues ad medium unidentati: tarsi simplices.* Sp. 12—15.

12. C. sufflatus, piceus, subtiliter grisco-pubescens, thorace latitudine sublongiore, antice posticeque angustato, lateribus rotundatis, valde convexo, subalutaceo, parce punctulato, elytris striis distincte punctatis, interstitiis subplanis vix punctulatis, antennis palpis pedibusque flavis. Long. ·20—·24.

Two specimens, San Diego, California. As in the other species of this division of the genus, the posterior angles of the thorax are longer than in the species above described, and project directly backwards: the basal striæ are tolerably long, but faint: the disc of the thorax is obsoletely channelled posteriorly: the elytra are more rounded at the humerus than in the other species, and are not wider than the thorax.

13. C. inanus, piceus, subtiliter grisco-pubescens, thorace latitudine sublongiore, antice posticeque angustato, lateribus rotundatis, valde convexo, subalutaceo, parce punctulato, elytris striis parcius punctatis, interstitiis planis, vix punctulatis, basi rufis, antennis piceis, pedibus flavis. Long. 1·0.

Two specimens, San Diego. Independently of size, distinguished by the piceous antennæ from the preceding, which it very much resembles in form: the striæ of the elytra are less impressed than in C. sufflatus: the thorax is rufo-piceous in one specimen.

14. C. transfugus, niger, subtiliter cinereo-pubescens, thorace latitudine sublongiore antice angustato, postice subangustato, lateribus rotundatis, valde convexo, subalutaceo, parce punctulato, basi biimpresso, elytris striis subprofundis subtilius punctatis, interstitiis subconvexis, piceis humeris late testaceis, pedibus antennisque flavis, his extrorsum fuscescentibus. Long. ·18.

One specimen, San Jose, California. This species is allied to the next, but the thorax is much more rounded on the sides: the basal striæ are reduced to extremely short fissures, and the space around them is broadly and tolerably deeply foveate: the humeral spot is oblong, and its posterior limit badly defined, appearing inclined to form an obsolete vitta, extending nearly to the tip of the elytra; the suture is darker than the rest of the elytra.

15. C. curiatus, niger, nitidus, griseo-pubescens, thorace latitudine vix longiore, lateribus late rotundatis, modice convexo, parce punctulato, elytris rufo-flavis, sutura, fascia lata ad medium, margineque pone medium nigris, striis profundis, subtilius punctatis, interstitiis convexis parce punctulatis, antennis palpis pedibusque flavis. Long. ·18.

Elater curiatus Say, Trans. Am. Phil. Soc. 6, 173.

Cardiophorus areolatus ‡ Er. Germ. Zeitschr. 2, 320.

Middle and Southern States, sometimes quite abundant. The basal fissures are here merely oblong punctures, but there appear to be two on each side, placed very near together. Erichson seems to have placed great confidence in Dejean's determination (vide *C. nigrofasciatus* Dej. Cat. p. 101) in considering this species as Elater areolatus *Say*, to which it has no resemblance.

Div. 5. CEBRIONITES.

The genera here contained are considered by most systematic entomologists as constituting a peculiar family: and indeed on comparing any species of Cebrio with Elater, it is difficult to come to any other conclusion. The number of genera composing the supposed family is very small, and they are, moreover, rare in collections, so that but little opportunity is afforded for studying the differences in structure. Having been so fortunate as to discover in our country a species of the very interesting genus Plastocerus, recognised as entering this family, and two other genera still more closely allied to Elater, I have been convinced of the necessity either of restricting the family Cebrionidæ to the genus Cebrio alone, (with my genus Scaptolenus, as probably a division of it,) distinguished by the fifth ventral segment of the abdomen being truncate; or to place the family Cebrionidæ as now received by entomologists with the Elateridæ, making of it a division equal in value to the genuine Elaters, and distinguished by having the mandibles long, and prominent; from the other great group containing the Eucnemidæ, and which appears to osculate with the present division in Perothops, the genera here contained differ by the antennæ being widely separated as in Elater.

The characters then of the present division are as follows:

Caput porrectum, oculis liberis; mandibulæ elongatæ, porrectæ, sæpe tenues; labrum præcipue connatum; clypeus antice non dilatatus; antennæ distantes, in fossulis vix distinctis insertæ; prosternum non lobatum, sutura laterali præcipue indistinctum, mucrone postico in aliis distincto, in aliis

valde inflexo, et inde indistincto; coxæ anticæ et intermediæ præcipue maiusculæ, posticæ laminis intus sensim dilatatis; tarsi pubescentes, non lobati, unguiculis simplicibus: abdomen articulo 5to in aliis rotundato, in aliis truncato.

Our genera may be thus arranged:

A. Abdomen articulo 5to postice rotundato, sexto abscondito:
- Antennæ filiformes; frons margine porrecto - - - - Aphricus.
- Antennæ flabellatæ; frons non marginata:
  - Antennæ 11-articulatæ - - - - - - Plastocerus.
  - Antennæ 12-articulatæ - - - - - - Euthysanius.

B. Abdomen articulo 5to truncato, 6to conspicuo: antennæ subserratæ:
- Tarsi mediocres, tibiæ anticæ apice paulo productæ - - - Cebrio.
- Tarsi longissimi, tibiæ anticæ bidentatæ - - - - - Scaptolenus.

Aphricus *Lec.*

Frons concava, antice subrotundata prominula; labrum brevissimum, sub fronte absconditum: mandibulæ elongatæ falcatæ tenues: palpi articulo ultimo vix dilatato: antennæ vix serratæ, articulis 2 et 3 coniunctis 4to æqualibus, (ultimo?); prosternum quadratum, lateribus rectis, antice truncatum, non lobatum, at linea transversa impressum, postice subito inflexum (non mucronatum?): coxæ intermediæ parvæ paulo distantes: posticæ valde obliquæ, laminis intus sensim paulo dilatatis: tarsi longiusculi, pubescentes, setosi, articulis 1—4 subæqualibus, 5to duplo longiore unguiculis integris: tibiæ omnes tenues, calcaribus parvis: abdomen 5-articulatum.

A small insect having very much the appearance of a slender cylindrical Cardiophorus, but by its long mandibles, and very short labrum, evidently belonging to the present group: the head is exserted, and the eyes are moderately prominent: the thorax is as long as it is wide, rounded on the sides, narrowed slightly towards the posterior angles, which are diverging and slender; the lateral margin is not apparent; the scutellum is emarginate in front, and acute behind; the elytra are scarcely wider than the thorax, and nearly parallel on the sides. The prosternum posteriorly is suddenly inflexed so much, that I am unable to see if it is mucronate at tip; the mesosternum, however, is visible between the middle coxæ, and appears concave in its deepest part; the middle coxæ are smaller than in the other genera of this group, and are visibly separated. The posterior coxæ are also divergent at their inner tip, as in the genuine Elateridæ; while in the following genera they lie close together.

The name is derived from *αφριχος* (*α* et *φριξ*) quasi *mutus*.

1. A. californicus, nigro-piceus, griseo-pubescens, capite scabro-punctato, thorace convexo, quadrato, lateribus rotundato, subtiliter punctulato, angulis posticis valde divergentibus, elytris striis punctatis, interstitiis punctulatis, 5to pone medium leviter carinato, antennis pedibusque piceis. Long. ·25.

One specimen, San Diego, California. The striæ of the elytra are deeper towards the base, so that the interstices are there slightly convex; posteriorly the striæ become merely rows of oblong points; the elevation of the fifth interstice behind the middle is altogether anomalous, and reaches quite to the apex.

Plastocerus † *Schaum.*

Frons planiuscula, antice sensim deflexa, non marginata: oculi convexi prominuli: labrum transversum antice rotundatum, cum fronte arcte connatum: mandibulæ longiusculæ, minus tenues, vix acutæ: palpi articulo ultimo vix longiore cylindrico: antennæ pilosæ, flabellatæ, 11-articulatæ, articulo 1mo crassiore; 2—10 gradatim paulo longioribus, 4—10 ramo externo cylindrico valde elongato apicali instructis; 11mo ramo præcedentis longiore, cylindrico: prosternum antice vix rotundatum, postice longe mucronatum: coxæ anticæ parvæ, mediæ maiusculæ contiguæ, posticæ laminis angustis intus paulo latioribus: tarsi longiusculi, pubescentes, articulis 1—4 sensim brevioribus, 5to longiore unguiculis integris: tibiæ tenues calcaribus minutis: abdomen 5-articulatum.

A specimen of this insect was sent by me to Dr. Schaum, who pronounced it strictly congeneric with Callirhipis angulosus *Germ.*, an insect found in Smyrna, and which forms in the Catalogus Coleopterorum Europæ the type of the unpublished genus Plastocerus.

The characters are very distinct, as given above; the general form of the body is that of Cebrio, but more slender; the mandibles are shorter and less acute than in the other genera of this group, and close together just beyond the labrum, so as to leave no open space as in Aphricus and Cebrio; the labrum is closely soldered to the front, as in Cebrio, leaving merely a transverse line; the small size of the anterior coxæ shows the persistence of the Elater type. The abdomen, though apparently only 5-jointed, is slightly dehiscent at the apex, permitting the sixth internal joint to be seen.

1. P. Schaumii, picco-castaneus, helvo-pubescens, capite thoraceque pilis longioribus erectis densius vestitis, illo scabro, hoc antrorsum angustato, lateribus sinuatis, angulis posticis elongatis, divergentibus, dense punctato, elytris striis vage impressis, interstitiis subrugosis, pectore longius cinereo-pubescente. Long. ·47.

San Diego, California, May and June, abundant, flying about just before sunset, and alighting on bushes, near the shore of the bay. In the male, the thorax is gradually narrowed from the base, and slightly angulated before the middle; in the female, the sides are parallel from the base of the spines to the middle, then rounded to the apex. This insect has very feebly the power of springing.

Euthysanius *Lec.*

Frons planiuscula, antice subito devexa, non marginata: oculi convexi prominuli: labrum breve, antice subsinuatum: mandibulæ modice elongatæ, acutæ, medio dentatæ: palpi articulo ultimo non longiore, cylindrico: antennæ pilosæ flabellatæ, 12-articulatæ, articulo 1mo crassiore, sequentibus duobus æquali; 3^io^ 2^ndo^ paulo longiore; 4—11 sensim paulo longioribus, ramo externo valde elongato, cylindrico apicali instructis, 12mo cylindrico, ramo præcedentis sesqui breviore: prosternum antice vix rotundatum, sutura laterali obliqua recta, postice mucronatum: coxæ anticæ parvæ, mediæ fere contiguæ, posticæ laminis angustis, intus latioribus: tarsi longiusculi pubescentes, articulis 1—4 sensim brevioribus, 5to longiore, unguiculis integris: tibiæ tenues, calcaribus parvis: abdomen 5-articulatum.

The appearance is entirely that of Plastocerus, but the 12-jointed antennæ, and the more prominent and acute mandibles, compel me to separate this species. The labrum is more porrected than in the preceding genus, and is nearly horizontal, not following the convexity of the anterior part of the front, which is almost perpendicular.

1. E. l a u t u s, picco-castaneus, tenuiter helvo-pubescens, capite thoraceque sat dense punctatis, hoc latitudine non breviore, antrorsum paulo angustato, lateribus late sinuatim rotundatis, angulis posticis elongatis valde divergentibus, elytris thorace paulo latioribus, seriatim punctatis, vage subsulcatis, rugose punctatis, antennis palpis pedibusque castaneo-rufis. Long. ·92.

One specimen from San Diego, California. The shallow furrows of the elytra are more obvious behind the middle.

Cebrio *Fabr.*

Frons paulo convexa, antice non marginata: oculi convexi prominuli: labrum latum, breve, antice præcipue late emarginatum, fronte arcte connatum: mandibulæ elongatæ fere rectangulariter angulatæ, apice tenues acutæ: palpi maxillares longiusculi, articulis cylindricis: antennæ subserratæ, 11-articulatæ, articulo 1mo non crassiore, 4to æquali; 2 et 3 coniunctis 4to æqualibus; 11mo apice subito constricto: prosternum breve, sutura laterali indistincta, postice longe mucronatum: coxæ anticæ maiusculæ, mediæ contiguæ, posticæ laminis intus subito dilatatis: tibiæ anticæ ad apicem extus paulo productæ, calcaribus mediocribus: tarsi paulo pubescentes longiusculi, articulo 1mo elongato, 2—4 subæqualibus, 5to longiore, unguiculis integris: abdomen articulo 5to truncato, 6to 7^mo^que conspicuis.

This genus is distinguished from the next by the anterior tibiæ being less compressed and not emarginate externally; the terminal spurs of all the tibiæ are moderate, while in Scaptolenus, they are very long; the scutellum is obtuse and not elongate. The species resemble each other very closely, and are only to be recognised by the organic differences pointed out below: they are castaneous above, and testaceous yellow below, with the prosternum dusky, and the antennæ ferruginous. Latreille has separated C. bicolor as a distinct genus Selenodon, but such an arrangement is not tenable.

A. *Palpi articulo ultimo maxillarium breviore.*

1. C. b i c o l o r, castaneus, helvo-pubescens, minus nitidus, labro late emarginato, thorace lateribus parallelis antice rotundatis, (maris confertim, feminæ parcius punctato,) angulis posticis subdivergentibus, elytris striatis, interstitiis punctatis, subtus testaceus, antennis ferrugineis. Long. (mas.) ·7: (fem.) ·9.

Cebrio bicolor Fabr. Syst. El. 2, 11; Beauvois, Ins. 8, tab. 7, fig. 2.

Selenodon bicolor Latreille, Ann. Ent. Soc. France, ser. 1, 3, 163.

Southern and Western States, not rare. The female is apterous, and larger and stouter in its form; the antennæ are only as long as the head and mandibles, while in the male they reach beyond the base of the thorax; they are serrate in both sexes, with the last joint acuminate: the only specimen of the female that I have seen, was taken in Alabama by Mr. Hentz, and given me by Prof. Haldeman. In both sexes the apical portion of the mandibles is slender: in the female the tarsi are shorter than in the male, and the anterior tibiæ are more compressed.

As this seems to be the most abundant species, it is probably the original Cebrio bicolor.

2. C. s i m p l e x, picco-castaneus, helvo-pubescens, labro non emarginato, thorace antrorsum subangustato, lateribus fere rectis (maris confertim fere confluenter punctato) angulis posticis subdivergentibus, elytris nitidis profundius striatis, interstitiis punctatis, subtus testaceus, antennis ferrugineis. Long. ·72.

One male from Georgia. The antennæ are a little longer than the head and thorax: besides the differences given in the diagnosis, the thorax is more densely pubescent than in the other species, and its posterior angles are more strongly carinated.

B. *Palpi maxillares articulo ultimo præcedenti æquali.*

3. C. confusus, piceus, helvo-pubescens, labro antice late emarginato, thorace lateribus parallelis, antice subrotundatis, angulis posticis breviusculis, non divergentibus (maris confertim subtilius punctato,) elytris minus nitidis, striatis, interstitiis punctatis, subtus testaceus, antennis ferrugineis. Long. ·72.

One male from Georgia. More robust than the preceding, almost intermediate in form between the male and female of C. bicolor. The antennæ hardly reach beyond the base of the thorax; the posterior angles of the thorax are not distinctly carinated: the front is somewhat more convex than in the other two species.

SCAPTOLENUS *Lec.*

Frons convexiuscula, non marginata; labrum latum antice leviter emarginatum, fronti arcte coniunctum: mandibulæ elongatæ tenues, falcatæ, acutæ; palpi elongati, tenues, articulo ultimo maxillarium præcedenti æquali: antennæ tenues, vix serratæ, 11-articulatæ, articulo 1mo vix crassiore, 4to æquali, 2 et 3 coniunctis 4to brevioribus, 11mo apice subito constricto; prosternum breve, postice valde inflexum, mucrone vix distincto: coxæ anticæ maiusculæ, mediæ contiguæ, posticæ laminis intus subsubito dilatatis: tibiæ calcaribus elongatis armatæ, anticæ compressæ, dilatatæ, extus emarginatæ, et apice productæ (ita ut bidentatæ sunt,): tarsi tenues, pubescentes, valde elongati, articulo 1mo sequentibus duobus longiore, 2—4 sensim paulo brevioribus, ultimo præcedentibus duobus breviore, unguiculis integris: abdomen articulo 5to truncato, 6to 7^{mo}que prominulis.

The body is short and thick, strongly narrowed in front from the base of the thorax; the anterior part of the body, above and beneath, is covered with very long hair. The scutellum is long and pointed.

1. S. femoralis, saturate castaneus, nitidus longe helvo-pilosus, punctatus, thorace valde transverso, antice fortiter angustato, lateribus subrotundatis, basi et apice bisinuato, angulis posticis elongatis, elytris postice subangustatis, sulcatis, sulcis antice obliteratis, subtus flavus, tibiis tarsisque nigricantibus, antennis ferrugineis, palpis piceis. Long. ·65.

Cebrio femoralis Chevrolat, Coléoptères de Mexique, fasc. 8, No. 200.

Two males found near San Antonio, Texas, by Lieut. H. Haldeman.

APPENDIX.

Page 451. In ATRACTOPTERUS add the following species:

A. silaceus, rufo-testaceus, fere opacus, tenuiter flavo-pubescens, thorace latitudine sesqui longiore, antrorsum subangustato, lateribus antice late rotundatis, angulis posticis pallidis subdivergentibus, disco confertissime subtiliter punctato, elytris fere parallelis pallidioribus, striis punctatis impressis, interstitiis vix convexis, punctatis, antennis articulis 2 et 3 æqualibus, 4to coniunctis fere æqualibus. Long. ·3—·34.

Elater silaceus Say, Ann. Lyc. of New York, 1, 260.

Middle and Southern States, not rare. This species differs from the following by its less slender form and less elongated antennæ. The head and thorax are somewhat darker than the elytra, but never become piceous or black: the thorax is very obsoletely channelled: the abdomen is rufous, and the postpectus dusky.

A. umbraticus, picco-niger, fere opacus, tenuiter flavo-pubescens, thorace latitudine sesqui longiore, antrorsum subangustato, lateribus vix rotundatis, angulis posticis testaceis subdivergentibus, confertissime punctato, elytris fere parallelis fuscis, versus basin pallidioribus, striis impressis, punctatis, interstitiis punctatis, pedibus antennisque fusco-testaceis, his valde elongatis, articulis 2 et 3 coniunctis 4to duplo brevioribus. Long. ·3.

Middle and Southern States. This is probably what Say alluded to as a variety of the preceding species, having the thorax and abdomen almost black. The thorax, as in A. silaceus, is very indistinctly channelled.

With regard to the difference between Atractopterus and Dolopius, of this essay, a few words of explanation may be necessary. The essential differences may be reduced to two: 1. The head of Atractopterus is not perpendicular, and the mouth not inferior; and 2. The basal joint of the antennæ is not elongated.

It may be a matter of dispute by what name the genus called Dolopius, in the present essay, should be properly denoted. I confess that I may have acted without due deliberation in selecting the name Dolopius, as it has already been placed as a synonym to Eetinus by Latreille: I would, therefore, propose to substitute for it Agnorus, as liable to fewer objections. My reason for selecting Dolopius was, that most of the native species previously described had been referred to that genus, and I was unwilling to introduce any change of name, except in cases where it was absolutely necessary. On consultation with Dr. Harris, his opinion, in which I am now happy to coincide, is, that if the genera are united, the choice of names should be restricted to Eetinus or Agriotes, since Latreille has united the other two (Dolopius and Sericosomus) with them.

Of the species described in this essay, D. mancus and D. pubescens differ from the others in having the mouth entirely closed by the sternum, and in this respect agree with Agriotes segetis of Europe. The basal fissures are more elongated than in the other species, and present in certain lights the appearance of elevated lines: it might be doubted which of the two is the real El. mancus *Say*, but as it is compared with El. convexus, evidently a robust species of Cardiophorus, I have given the preference to that having the more robust form.

D. pauper, D. substus, D. bigeminatus, D. oblongicollis, D. isabellinus, and D. avulsus, agree closely in characters with the European D. marginatus, which is the type of Eschscholtz's genus Dolopius: in them the posterior coxæ are somewhat suddenly dilated internally; in the remaining species the coxæ are hardly wider internally, and the second and third joints of the antennæ are variable in their proportions: united together, they are longer than the fourth; they are equal in size, or nearly so; but in D. limosus the second appears distinctly longer than the third; the suture of the prosternum is more or less excavated anteriorly, and in all of them to a greater extent than in the European D. marginatus.

Under these circumstances, I did not feel justified in separating such closely allied species into different genera, though I confess that the following arrangement of the species described would be more natural than the one proposed in the text, although the thickened and emarginate mandibles separate A. mancus from all the other species, both native and foreign, that I have examined:

A. Sternum subtus os omnino obtegens: A. mancus and pubescens.

B. Os subtus plus minusve liberum:
Coxæ posticæ intus vix latiores: A. collaris, fucosus, sordidus.
Coxæ posticæ intus modice, subgradatim angustatæ: A. avulsus, sordidus, stabilis, limosus.
Coxæ posticæ intus modice fere subito angustatæ:
Antennæ articulis 2 et 3 coniunctis 4to brevioribus: A. isabellinus and oblongicollis.
Antennæ articulis 2 et 3 coniunctis 4to longioribus, (frons apice subangulata:) A. pauper, subustus, bigeminatus.

The following note from Dr. Harris will explain the different views taken by us of the nomenclature of the species, considered by Dr. Harris as El. obesus, and by me as Elater mancus.

"The species which Dr. Le Conte refers to *Elater mancus* of Say, is strictly congerical with the European species *segetis* Gyll. (*striatus* Fabr.) *variabilis* F., and *sputator* F., with all of which it has been carefully compared. These species belong to the genus Agriotes of Eschscholtz and of Latreille. The insect in question is to be found in the 'Catalogue of the insects of Massachusetts,' appended to the 2d edition of Hitchcock's Report, under the name *E. pumilus*, with the doubtful synonym, '*obesus?* var. S.,' given on the authority of Mr. Say: and it is described as *Elater* (*Agriotes*) *obesus* in the 'Treatise on Insects Injurious to Vegetation,' in which the specific name was adopted in deference to Mr. Say, although the writer was previously aware that the insect did not accord with Mr. Say's description of the *obesus*."

The following species of this family are unknown to me; those described from Russian

America may be expected to occur in the northern portion of Oregon, but are not included here, as a catalogue of them has already been published by Mannerheim, (Bull. Mosc., 1852.)

Where the genus can be determined, it is placed in parentheses, or reference is made to the preceding pages, where the species is mentioned:

Eucnemis quadricollis Say, (v. p. 411.)
Galba (Dendrocharis) flavicornis Guér. (v. p. 418.)
(Eucnemis) subrufa Randall, Bost. Journ. 2, 38.
dispar Herbst, Käfer, 10, 72, tab. 164, fig. 6.
flavipes Fabr. Syst. El. 2, 234: Herbst, ibid. 71, tab. 164, fig. 6.
lepturus Herbst, ibid. 77, tab. 165, fig. 1.
stigma Herbst, (v. 435, 471.)
scutellum Herbst, Käfer, 10, 144.
inquinatus Say, (v. 459.)
quietus Say, (v. 459.)
avitus Say, (v. 491.)
erosus Say, Ann. Lyc. 1, 258.
rufifrons Randall, (v. 427.)
Elater acutipennis Randall, Bost. Journ. 2, 36.
nimbatus Say, Ann. Lyc. 1, 265.
claricollis Say, Trans. Am. Phil. Soc. 6, 179.
bisectus Say, Journ. Acad. Nat. Sc. 3, 177.
convexus Say, (v. 497.)
abbreviatus Say, Journ. Acad. Nat. Sc. 3, 173.
militaris Harris, Transac. Hartford Soc. 70: Germ. Zeitschr. 5, 161.
basalis Randall, Bost. Journ. Nat. Hist. 2, 9.
honestus Randall, Bost. Journ. Nat. Hist. 2, 9.
filius Randall, ibid. 2, 14.
griseus Beauv., 214, tab. 9, fig. 8. (Limonius sec. Chevrolat.)
rufipes Beauv., 214, tab. 9, fig. 9.
Elater choris Say, (v. 489.)
viridis Say, Ann. Lyc. 4, 255.
obesus Say, (v. 456.)
macilentus Randall, Bost. Journ. 2, 13,
Dolopius californicus Mann. Bull. Mosc., 1843.
xanthomus Germ. (v. 471.)
pullus, (v. 468:) Germ. Zeitschr. 5, 168.
Ampedus pusio, Germ. Zeitschr., ibid.
cribrarius Germ. (v. 472.)
pedalis Germ. (v. 468.)
concinnus Germ. (v. 470.)
bombycinus Germ. Zeitschr. 4, 70.
medianus Germ. (v. 437.)
corporosus Germ. ibid. 4, 72.
sticticus Germ. (v. 441.)
Dracanthus russicollis Germ. (v. 441.)
submetallicus Germ. 4, 72.
leucaspis Germ. 4, 73.
glaucus Germ. 4, 76.
serricornis Mann. Bull. Mosc., 1843, 241.
diversicolor Mann., ibid. 243.
Corymbetes rupestris Germ. Zeitschr.
Cryptohypnus cinereipennis Mann. (v. 460.)
Cryptohypnus puberulus Mann. (v. 460.)
Cardioph. latiusculus Esch. Mann. Bull. Mosc., 1843, 238.
californicus Mann. ibid. 238.
tantillus Mann. ibid. 239.
Cratonychus (species) (v. 481.)

The Elaters operculatus, fenestratus, and mendica, mentioned by Say as having been described by him, cannot be found in his writings.

On p. 439 a duplicate description of Corymbites aratus has been inadvertently allowed to remain: the remarks under the first of the descriptions are a repetition of what belongs to C. nitidulus.

INDEX OF GENERA.

Adelocera, 489.
Adrastus, 458.
Agriotes, 505, (456, 457.)
Agrypnus, 491.
Alaus, 496.
Ampedus, 463.
Anchastus, 459.
Anclastes, 413.
Aphanobius, 492, (453, 463.)
Aphotistus, 439.
Aphricus, 501.
Asaphes, 449.
Athous, 427, (425, 426, 447, 450, 451, 453.)
Atractopterus, 454, 505.

Blauta, 472.
Brachyerepis, 460.

Calocerus, 428.
Campylus, 423, (447.)
Cardiophorus, 496.
Cebrio, 503.
CEBRIONITES, 500.
CEROPHYTIDES, 420.
Cerophytum, 421.
Chalcolepidius, 495.
Chorea, 42.
Corymbites, 435, (430.)
Cratonychus, 473.
Crigmus, 453.
Cryptohypnus, 486, (484.)
Ctenicerus, 444.
Ctenonychus, 475.

Dendrochares, 418.
Diacanthus, 437, 439, 441, 443.
Dierepidius, 461.
Dirhagus, 416.
Dolopius, 455.

Ectinus, 463.
Elater, 463, (419, 417.)
ELATERIDES, 421.

Emathion, 414.
Epiphanis, 415, (414.)
EUCNEMIDES, 412.
Eucnemis, 417, (411.)
Euryptychus, 415.
Euthysanius, 502.

Fornax, 415.

Galba, 418.
Gambrinus, 435.

Hemicrepidius, 450.
Hemirhipus, 486.
Hylochares, 413, (416.)

Isarthrus, 417.

Limonius, 428, (426.)
Ludius, 455.

Melanotus, 475, 477, 481.
Melanactes, 492.
MELASIDES, 410.
Microrhagus, 418.
Melasis, 411, (412, 414.)
Monocrepidius, 481.

Nematodes, 412.

Oedostethus, 489.
Oestodes, 423.
Onychodon, 416.
Oophorus, 483.

Pedetes, 424, (450.)
Perimicus, 477.
Perothops, 421.
Pityobius, 428.
Plastocerus, 502.
Pristilophus, 443, 492.
Pyrophorus, 492.

Scaptolenus, 504.
Selenodon, 503.
Silenus, 413.

Tharops, 111.

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